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76 SOLID-STATE PHYSICS 700
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 708
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) 708
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 712
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 712
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 713
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 714
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 715

89 ASTRONOMY 715
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 716
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION N.A.
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 718
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 719
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 719

Note: N.A. means that no abstracts were assigned to this category for this issue.

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TYPICAL CITATION AND ABSTRACT

NASA SPONSORED
ON MICROFICHE
ACCESSION NUMBER
N89-11793*#
Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
CORPORATE SOURCE
TITLE
CONTROL OF FLEXIBLE STRUCTURES-2 (COFS-2) FLIGHT CONTROL, STRUCTURE AND GIMBAL SYSTEM INTERACTION STUDY Final Report
AUTHORS
Stanley Fay, Stephen Gates, Timothy Henderson, Lester Sackett, Kim Kirchwey, Isaac Stoddard, and Joel Storch
Sep. 1988
205 p
PUBLICATION DATE
CONTRACT OR GRANT
(Contract NAS9-17560)
REPORT NUMBERS
(NASA-CR-172095; R-2088; NAS 1.26:172095)
Avail: NTIS HC
AVAILABILITY SOURCE
PRICE CODE
A10/MF A01 CSCL 22B
COSATI CODE
The second Control Of Flexible Structures Flight Experiment (COFS-2) includes a long mast as in the first flight experiment, but with the Langley 15-m hoop column antenna attached via a gimbal system to the top of the mast. The mast is to be mounted in the Space Shuttle cargo bay. The servo-driven gimbal system could be used to point the antenna relative to the mast. The dynamic interaction of the Shuttle Orbiter/COFS-2 system with the Orbiter on-orbit Flight Control System (FCS) and the gimbal pointing control system has been studied using analysis and simulation. The Orbiter pointing requirements have been assessed for their impact on allowable free drift time for COFS experiments. Three fixed antenna configurations were investigated. Also simulated was Orbiter attitude control behavior with active vernier jets during antenna slewing. The effect of experiment mast dampers was included. Control system stability and performance and loads on various portions of the COFS-2 structure were investigated. The study indicates possible undesirable interaction between the Orbiter FCS and the flexible, articulated COFS-2 mast/antenna system, even when restricted to vernier reaction jets. Author

VOLUME 27 NUMBER 5 / MARCH 8, 1989

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N89-13394# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Logistics and Human Factors Div.
DIGITAL AIRCRAFT DAMAGE ASSESSMENT AND REPAIR Interim Report, Nov. 1985 - Dec. 1986
Gail A. Hudson and Donald L. Thomas Sep. 1988 46 p
(AD-A199095; AFHRL-TP-88-22) Avail: NTIS HC A03/MF A01 CSCL 01C

This paper describes a preliminary effort to develop and evaluate a computer based system to provide specialized technical data for use by technicians in assessing damage to aircraft resulting from accident or battle damage. The system used two and three dimensional computer graphics to represent aircraft structures and systems. The graphics provide information to aid the technician in identifying damaged components. The system also provides ready access to parts and repair information. A prototype was developed using off-the-shelf equipment and evaluated by having technicians and engineers use the system for a series of assessment exercises. The results indicate that the concepts tested have significant potential to improve the damage assessment process. However, advances in hardware and software technology are required to make such a system practical. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

* For related information see also *34 Fluid Mechanics and Heat Transfer.*

N89-13395*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A WATER TUNNEL STUDY OF GURNEY FLAPS
Dan H. Neuhart (PRC Systems Services Co., Hampton, Va.) and Odis C. Pendergraft, Jr. Nov. 1988 21 p Original contains color illustrations
(NASA-TM-4071; L-16467; NAS 1.15:4071) Avail: NTIS HC A03/MF A01 CSCL 01A

Several Gurney flap configurations were tested in the NASA Langley 16 x 24 inch Water Tunnel. These devices provided an increased region of attached flow on a wing upper surface relative to the wing without the flaps. The recirculation region behind the flap was visualized and shown to be consistent with hypotheses stated in previous research. Although the test Reynolds number for this study was several orders of magnitude below those in previous investigations, the effect of the Gurney flaps is in qualitative agreement with them. This is as would be expected from first order effects for high lift devices. Author

N89-13396*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THEORETICAL DERIVATION AND CALIBRATION TECHNIQUE OF A HEMISPHERICAL-TIPPED, FIVE-HOLE PROBE
Scott O. Kjelgaard Dec. 1988 27 p
(NASA-TM-4047; L-16454; NAS 1.15:4047) Avail: NTIS HC A03/MF A01 CSCL 01A

A technique is presented for the calibration of a hemispherical tipped 0.125 inch diameter 5-hole probe. The derivation of equations from the potential flow over a sphere relating the flow angle and velocity to pressure differentials measured by the probe is presented. The technique for acquiring the calibration data and the technique used to calculate the calibration coefficients are presented. The accuracy of the probe in both the uniform calibration flow field and the nonuniform flow field over a 75 degree swept delta wing is discussed. Author

N89-13397*# Purdue Univ., West Lafayette, Ind.
ANALYSIS OF SUPERSONIC PLUG NOZZLE FLOWFIELD AND HEAT TRANSFER
S. N. B. Murthy and W. H. Sheu Sep. 1988 180 p
(Grant NAG3-281)
(NASA-CR-179554; NAS 1.26:179554) Avail: NTIS HC A09/MF A01 CSCL 01A

A number of problems pertaining to the flowfield in a plug nozzle, designed as a supersonic thruster nozzle, with provision for cooling the plug with a coolant stream admitted parallel to the plug wall surface, were studied. First, an analysis was performed of the inviscid, nonturbulent, gas dynamic interaction between the primary hot stream and the secondary coolant stream. A numerical prediction code for establishing the resulting flowfield with a dividing surface between the two streams, for various combinations of stagnation and static properties of the two streams, was utilized for illustrating the nature of interactions. Secondly, skin friction coefficient, heat transfer coefficient and heat flux to the plug wall were analyzed under smooth flow conditions (without shocks or separation) for various coolant flow conditions. A numerical code was suitably modified and utilized for the determination of heat transfer parameters in a number of cases for which data are available. Thirdly, an analysis was initiated for modeling turbulence processes in transonic shock-boundary layer interaction without the appearance of flow separation. Author

N89-13398*# Analytical Services and Materials, Inc., Hampton, Va.
A GENERALIZED CHEMISTRY VERSION OF SPARK
Mark H. Carpenter Washington NASA 1988 27 p
(Contract NAS1-18599)
(NASA-CR-4196; NAS 1.26:4196) Avail: NTIS HC A03/MF A01 CSCL 01A

An extension of the reacting H2-air computer code SPARK is presented, which enables the code to be used on any reacting flow problem. Routines are developed calculating in a general fashion, the reaction rates, and chemical Jacobians of any reacting system. In addition, an equilibrium routine is added so that the code will have frozen, finite rate, and equilibrium capabilities. The reaction rate for the species is determined from the law of mass action using Arrhenius expressions for the rate constants. The Jacobian routines are determined by numerically or analytically differentiating the law of mass action for each species. The equilibrium routine is based on a Gibbs free energy minimization routine. The routines are written in FORTRAN 77, with special consideration given to vectorization. Run times for the generalized routines are generally 20 percent slower than reaction specific

routines. The numerical efficiency of the generalized analytical Jacobian, however, is nearly 300 percent better than the reaction specific numerical Jacobian used in SPARK. Author

N89-13399*# Flow Research, Inc., Kent, Wash.
USER'S MANUAL FOR AN AERODYNAMIC OPTIMIZATION SCHEEME THAT UPDATES FLOW VARIABLES AND DESIGN PARAMETERS SIMULTANEOUSLY Flow Report No. 444
Magdi H. Rizk Jul. 1988 33 p
(Contract NAS3-24855)
(NASA-CR-182180; NAS 1.26:182180) Avail: NTIS HC A03/MF A01 CSCL 01A

This user's manual is presented for an aerodynamic optimization program that updates flow variables and design parameters simultaneously. The program was developed for solving constrained optimization problems in which the objective function and the constraint function are dependent on the solution of the nonlinear flow equations. The program was tested by applying it to the problem of optimizing propeller designs. Some reference to this particular application is therefore made in the manual. However, the optimization scheme is suitable for application to general aerodynamic design problems. A description of the approach used in the optimization scheme is first presented, followed by a description of the use of the program. Author

N89-13400*# Vigyan Research Associates, Inc., Hampton, Va.
WALL ADJUSTMENT STRATEGY SOFTWARE FOR USE WITH THE NASA LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL ADAPTIVE WALL TEST SECTION
Stephen W. D. Wolf Nov. 1988 188 p
(Contract NAS1-17919)
(NASA-CR-181694; NAS 1.26:181694) Avail: NTIS HC A09/MF A01 CSCL 01A

The Wall Adjustment Strategy (WAS) software provides successful on-line control of the 2-D flexible walled test section of the Langley 0.3-m Transonic Cryogenic Tunnel. This software package allows the level of operator intervention to be regulated as necessary for research and production type 2-D testing using and Adaptive Wall Test Section (AWTS). The software is designed to accept modification for future requirements, such as 3-D testing, with a minimum of complexity. The WAS software described is an attempt to provide a user friendly package which could be used to control any flexible walled AWTS. Control system constraints influence the details of data transfer, not the data type. Then this entire software package could be used in different control systems, if suitable interface software is available. A complete overview of the software highlights the data flow paths, the modular architecture of the software and the various operating and analysis modes available. A detailed description of the software modules includes listings of the code. A user's manual is provided to explain task generation, operating environment, user options and what to expect at execution. Author

N89-13401*# Analytical Services and Materials, Inc., Hampton, Va.
DEVELOPMENT OF THREE-DIMENSIONAL CODE FOR THE ANALYSIS OF JET MIXING PROBLEM. PART 1: LAMINAR SOLUTION
Khaled S. Abdol-Hamid Washington NASA Dec. 1988 49 p
(Contract NAS1-18599)
(NASA-CR-4200; NAS 1.26:4200) Avail: NTIS HC A03/MF A01 CSCL 01A

Future aircraft will eventually feature nonaxisymmetric or rectangular nozzles. Developing a three-dimensional code to stimulate the characteristics of the jet exhaust plume, issuing from nonaxisymmetric nozzles, in general, at different flight conditions, is very important. Two three-dimensional codes were developed to simulate the shock-cell structure of circular nozzles. These codes were developed to solve the parabolized and simplified Navier-Stokes equations respectively. Both codes are based on a method previously developed by Newsome et al. These codes are fully vectorized on the VPS 32 at NASA Langley Research Center. The axisymmetric underexpanded supersonic jet flow problem, exhausting into still air, was used as a test case for developing an efficient three-dimensional problems and preserving crossplane symmetry of the flow downstream of the jet exit. Author

N89-13402# General Dynamics/Fort Worth, Tex.
UNSTEADY LOW-SPEED WINDTUNNEL TEST OF A STRAKED DELTA WING, OSCILLATING IN PITCH. PART 4: PLOTS OF TIME HISTORIES OF PRESSURES AND OVERALL LOADS Final Report, Jun. 1985 - Aug. 1987
A. M. Cunningham, Jr., R. G. Den Boer, C. S. Dogger, E. G. Geurts, and A. J. Persoon Apr. 1988 274 p Prepared in cooperation with National Aerospace Lab., Amsterdam (Netherlands)
(Contract F33615-85-C-3013)
(AD-A198682; AFWAL-TR-87-3098-Pt-4) Avail: NTIS HC A12/MF A01 CSCL 01A

Results of a wind tunnel test of an oscillating straked wing. The report provides unsteady airloads and pressure distributions for a range of incidences (-8 to 50 deg) and amplitudes (1 to 16 deg). The wind speed was 80 meters/second, which provided reduced frequencies up to 0.50 based on root chord. The zeroth and first harmonic as well as the continuous time history of the pressure and overall loads were measured. Flow visualization was performed for flow of 30 meters/second using a pulsating laser light sheet. In part 4, the plots of time history data for both pressures and overall air loads for continuous oscillating model are presented for conditions in which non-linearities and higher harmonics are expected. Appendix A includes the pressure plots in a carpet format which shows the distributions at every 45 deg of phase angle in a manner similar to the unsteady flow visualization photos. The distributions are shown similarly for all four pressure sections. A survey of the test conditions and their runnumbers is given in table 10 of part 1. Appendix B includes plots of overall air loads vs. incidence for continuous oscillating model. A survey of the runnumbers of these plots is given in table 11 of part 1. GRA

N89-13403# General Dynamics/Fort Worth, Tex.
UNSTEADY LOW-SPEED WINDTUNNEL TEST OF A STRAKED DELTA WING, OSCILLATING IN PITCH. PART 5: POWER SPECTRAL DENSITY PLOTS OF THE OVERALL LOADS FOR HARMONIC OSCILLATION AND THE RESPONSE OF OVERALL LOADS TO (1-COS) INPUTS Final Report, Jun. 1985 - Aug. 1987
A. M. Cunningham, Jr., R. G. Den Boer, C. S. Dogger, E. G. Geurts, and A. J. Persoon Apr. 1988 292 p Prepared in cooperation with National Aerospace Lab., Amsterdam (Netherlands)
(Contract F33615-85-C-3013)
(AD-A198683; AFWAL-TR-87-3098-Pt-5) Avail: NTIS HC A13/MF A01 CSCL 01A

Results are discussed of a wind tunnel test of an oscillating straked wing. The report provides unsteady airloads and pressure distributions for a range of incidences (-8 to 50 deg) and amplitudes (1 to 16 deg). The wind speed was 80 meters/second, which provided reduced frequencies up to 0.50 based on root chord. The zeroth and first harmonic as well as the continuous time history of the pressure and overall loads were measured. Flow visualization was performed for flow of 30 meters/second using a pulsating laser light sheet. The power spectral densities for various conditions present the relative frequency content of selected overall loads at continuous oscillating model conditions ranging from nearly linear (first harmonic dominant) to highly nonlinear (many higher harmonics) characteristics. A survey of the selected runs and their test conditions is given including the components of the balance and the corresponding plot numbers of the spectra presented. The time history plots are given of incidence and all air loads for (1-cos) pitch pulses that simulate transient aircraft maneuvers. Included are half pulse data which represent a pitch-up and hold at a higher angle of attack as well as a pitch-down and hold at a lower angle of attack. To give an idea of the reproducibility plots for all three runs of the balance components vs. incidence for two test conditions are also enclosed at the end. GRA

N89-13404# General Dynamics/Fort Worth, Tex.
UNSTEADY LOW-SPEED WINDTUNNEL TEST OF A STRAKED DELTA WING, OSCILLATING IN PITCH. PART 6: PRESENTATION OF THE VISUALIZATION PROGRAM Final Report, Jun. 1985 - Aug. 1987
A. M. Cunningham, Jr., R. G. Den Boer, C. S. Dogger, E. G. Geurts, and A. J. Persoon Apr. 1988 108 p
(Contract F33615-85-C-3013)
(AD-A198684; AFWAL-TR-87-3098-Pt-6) Avail: NTIS HC A06/MF A01 CSCL 01A

Results of a wind tunnel test of an oscillating straked wing are presented. The report provides unsteady airloads and pressure distributions for a range of incidence (-8 to 50 deg) and amplitudes (1 to 16 deg). The wind speed was 80 meters/second, which provided reduced frequencies up to 0.50 based on root chord. The zeroth and first harmonic as well as the continuous time history of the pressure and overall loads were measured. Flow visualization was performed for flow of 30 meters/second using a pulsating laser light sheet. In part 6 results of the flow visualization investigation are presented in the appendix in the form of tables and plots of vortex core positions, both as a function of phase angle during one cycle of oscillation. Table 13a through c in part 1 provides a convenient cross-reference of test conditions and the table numbers in this part. The phase angles are varied in steps on 45 deg so that a time history is developed during one cycle. When it was impossible to measure vortex core positions, due to either vortex burst or overexposure, no values are given in the tables and plots. Results are presented for the three laser light screen positions. The entries in the table for the aft position near the wing trailing edge are limited because very few core position measurements were possible due to vortex bursting. GRA

N89-13405# Boeing Commercial Airplane Co., Seattle, Wash.
COUPLING LINEARIZED FAR-FIELD BOUNDARY CONDITIONS WITH NONLINEAR NEAR-FIELD SOLUTIONS IN TRANSONIC FLOW Final Report, 1 Jul. 1983 - 29 Feb. 1988
William S. Rowe and F. E. Ehlers 29 Feb. 1988 175 p
(Contract F49620-83-C-0118)
(AD-A198721; D6-52895; AFOSR-88-0719TR) Avail: NTIS HC A08/MF A01 CSCL 01A

Research has been conducted to evaluate the feasibility of coupling linearized far-field solutions with near-field finite difference equations to reduce the number of unknowns and thus the computer resources required in transonic flow calculations. For two dimensional flow, changes to an existing finite difference program involved distributing sources on the grid boundary in order to obtain the proper far field outgoing wave boundary conditions on a reduced grid. Validation of the matching procedure was made for zero thickness airfoils by comparison of the results with those of the kernel function method. For airfoils with finite thickness, a criterion based on the gradient of the flowfield Mach number was developed for establishing the minimum size finite difference region necessary for accurate unsteady calculations. This approach could not be applied directly to three-dimensional flow because of the large number of variables required in the exterior solution. However, it is shown that the number of unknowns can be reduced to a practical number by using both source and doublet distributions on the boundaries, describing these distributions with low-order polynomials, and using a least squares procedure to satisfy the matching conditions across the boundaries. GRA

N89-13406# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamics Lab.
THE ORBITAL-PLATFORM CONCEPT FOR NONPLANAR DYNAMIC TESTING
M. E. Beyers and X. Z. Huang May 1988 41 p
(AD-A199119; NAE-AN-52; NRC-29133) Avail: NTIS HC A03/MF A01 CSCL 01A

A new concept is introduced for large-amplitude nonplanar testing at high incidence. The dynamic test apparatus is characterized by an annular, orbital platform on which the model support and secondary drive mechanisms are mounted. The device can be used as a rotary apparatus, while arbitrary epicyclic motions (including fixed-plane, orbital modes) and oscillatory motions superimposed on the coning mode may be generated. The system is inherently very rigid and vibration levels can be kept very low. Aerodynamic interference is also very low as there is no need for bulky support hardware and the test section is circular. Accordingly, the system may be used to assess levels of support interference in conventional rotary tests. GRA

N89-13407# Army Natick Research and Development Command, Mass.
PERFORMANCE OF A SINGLE BALLOON-SKIRT AIRBAG IN VERTICAL DROPS Final Report, Oct. 1986 - Sep. 1987
Calvin K. Lee Jul. 1988 49 p
(AD-A198240; NATICK/TR-88/059) Avail: NTIS HC A03/MF A01 CSCL 15E

Airbags are currently being investigated by the Army as an alternative to paper honeycomb and retrorockets for soft landing of airdropped payloads. A double-chamber balloon skirt airbag developed by a French company was claimed to provide low impact G forces and ground gliding capability. The performance of an eight balloon-skirt airbag-platform system was investigated in a previous study at NRDEC. The performance of the system was not satisfactory. In an attempt to improve the performance, a single balloon-skirt was modified in the current study and its performance was investigated at various test conditions. Test results showed that the double-chamber design of the balloon-skirt airbag is moderately better than the single-chamber design but its performance is still not as good as the manufacturer claimed. GRA

N89-13408*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AERODYNAMIC DESIGN VIA CONTROL THEORY Final Report
Antony Jameson Nov. 1988 42 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181749; ICASE-88-64; NAS 1.26:181749) Avail: NTIS HC A03/MF A01 CSCL 01A

The question of how to modify aerodynamic design in order to improve performance is addressed. Representative examples are given to demonstrate the computational feasibility of using control theory for such a purpose. An introduction and historical survey of the subject is included. Author

N89-13409*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LASER VELOCIMETER MEASUREMENTS OF THE FLOWFIELD GENERATED BY AN ADVANCED COUNTERROTATING PROPELLER
Gary G. Podboy and Martin J. Krupar 1989 33 p Prepared for presentation at the 27th Aerospace Sciences Meeting, Reno, Nev., 9-12 Jan. 1989; sponsored by AIAA
(NASA-TM-101437; E-4525; NAS 1.15:101437; AIAA-89-0434)
Avail: NTIS HC A03/MF A01 CSCL 01B

Results are presented of an investigation to measure the flowfield generated by an advanced counterrotating pusher propeller model similar to the full-scale Unducted Fan demonstrator engine. A laser Doppler velocimeter was used to measure the velocity field in several planes normal to the centerline of the model at axial stations upstream and downstream of each rotor. During this investigation, blades of the F4/A4 type were installed on the model which was operating in a freestream Mach 0.72 regime, with the advance ratio of each rotor set at 2.80. The measured data indicate only a slight influence of the potential field of each front rotor blade on the flowfield upstream of the rotor. The data measured downstream of the front rotor characterize the tip vortices, vortex sheets and potential field nonuniformities generated by the front rotor. The unsteadiness of the flow in the rotating frame of reference of the aft rotor is also illustrated. Author

N89-13410*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HUB LOADS ANALYSIS OF THE SA349/2 HELICOPTER
R. M. Heffernan, G. K. Yamauchi, M. Gaubert, and W. Johnson (Johnson Aeronautics, Palo Alto, Calif.) Dec. 1988 40 p Presented at the 14th European Rotorcraft Forum, Milano, Italy, 20-23 Sep. 1988
(NASA-TM-101061; A-88270; NAS 1.15:101061) Avail: NTIS HC A03/MF A01 CSCL 01C

The forces and moments at the rotor hub of an Aerospatiale SA349/2 helicopter were investigated. The study included three main topics. First, measured hub forces and moments for a range of level flight conditions (mu = 0.14 to 0.37) were compared with predictions from a comprehensive rotorcraft analysis to examine the influence of the wake model on the correlations. Second, the effect of changing the blade mass distribution and blade chordwise center of gravity location on the 3/rev nonrotating frame hub loads was studied for a high-speed flight condition (mu = 0.37). Third, the use of higher harmonic control to reduce nonrotating frame 3/rev hub shear forces was investigated. The last two topics were theoretical studies only. Author

N89-13411*# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
DESIGN OF HIGH-REYNOLDS-NUMBER FLAT-PLATE EXPERIMENTS IN THE NTF Final Report
William S. Saric 19 Dec. 1988 18 p
(Contract NCC1-89)
(NASA-CR-184627; NAS 1.26:184627) Avail: NTIS HC A03/MF A01 CSCL 01A

The design of an experiment to measure skin friction and turbulent boundary layer characteristics at Reynolds numbers exceeding 1 x 10 to the 9th is described. The experiment will be conducted in a zero-pressure-gradient flow on a flat plate in the National Transonic Facility (NTF). The development of computational codes to analyze the aerodynamic loads and the blockage is documented. Novel instrumentation techniques and models, designed to operate in cryogenic environments, are presented. Special problems associated with aerodynamic loads, surface finish, and hot-wire anemometers are discussed. Author

N89-13412*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTIONS OF AIRFOIL AERODYNAMIC PERFORMANCE DEGRADATION DUE TO ICING
Robert J. Shaw, Mark G. Potapezuk, and Colin S. Bidwell [1988] 16 p Presented at the 4th Symposium on Numerical and Physical Aspects of Aerodynamic Flows, Long Beach, Calif., 16-19 Jan. 1989; sponsored by California State Univ.
(NASA-TM-101434; E-4541; NAS 1.15:101434) Avail: NTIS HC A03/MF A01 CSCL 01A

An overview of NASA's ongoing efforts to develop an airfoil icing analysis capability is developed. An indication is given to the approaches being followed to calculate the water droplet trajectories past the airfoil, the buildup of ice on the airfoil, and the resultant changes in aerodynamic performance due to the leading edge ice accretion. Examples are given of current code capabilities/limitations through comparisons of predictions with experimental data gathered in various calibration/validation experiments. A brief discussion of future efforts to extend the analysis to handle three dimensional components is included. Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N89-13413# National Transportation Safety Board, Washington, D. C. Bureau of Field Operations.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AND FOREIGN AVIATION, ISSUE NUMBER 4 OF 1987 ACCIDENTS
27 May 1988 399 p
(PB88-916908; NTSB/AAB-88/08) Avail: NTIS HC A17/MF A01; also available on subscription, North American Continent HC $185.00/year; all others write for quote CSCL 01C

Reports of selected aircraft accidents that occured in U.S. civil and foreign aviation operations during 1987 are given in brief format. Approximately 200 general aviation and air carrier accidents contained in the publication represent a random selection. The facts, conditions, circumstances and probable cause(s) for each accident are given. GRA

N89-13414*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry and Mechanical Engineering.
A FUNDAMENTAL APPROACH TO THE STICKING OF INSECT RESIDUES TO AIRCRAFT WINGS Final Report
O. Yi, N. S. Eiss, and J. P. Wightman Sep. 1988 117 p
(Grant NAG1-300)
(NASA-CR-183041; NAS 1.26:183041; Rept-118; CAS/CHEM-29-88) Avail: NTIS HC A06/MF A01 CSCL 01C

The aircraft industry is concerned with the increase of drag on planes due to the sticking of insects on critical airfoil areas. The objectives of the present study were to investigate the effects of surface energy and elasticity on the number of insects sticking onto the polymer coatings on a modified aircraft wing and to determine the mechanism by which insects stick onto surfaces during high velocity impact. Analyses including scanning electron microscopy, electron spectroscopy for chemical analysis and contact angle measurements of uncoated and polymer coated aluminum surfaces were performed. A direct relation between the number of insects sticking on a sample and its surface energy was obtained. Since the sticky liquid from a burst open insect will not spread on the low energy surface, it will ball up providing poor adhesion between the insect debris and the surface. The incoming air flow can easily blow off the insect debris and thus reducing the number of insects that remain stuck on the surface. Also a direct relation between the number of insect sticking onto a surface and their modulus of elasticity was obtained. Author

N89-13415# Science and Engineering Associates, Inc., Seattle, Wash.
LIGHTNING SIMULATION TEST TECHNIQUE EVALUATION Final Report, Sep. 1984 - Sep. 1987
William W. Cooley and Deborah L. Shortess Oct. 1988 130 p
(Contract DTFA03-84-C-00064)
(DOT/FAA/CT-87/38) Avail: NTIS HC A07/MF A01

The results of four separate lightning simulation tests on a specially designed test bed aircraft is documented. The simulation techniques utilized are low-level swept continuous wave, low-level fast rise pulse, moderate-level pulse, and shock-excitation. The test bed is made up of advanced composite materials with built-in lightning protection and electrical equipment installations. This configuration is electrically and geometrically representative of a general aviation heavy single engine aircraft. Comparative data was developed to determine the effectiveness of the four test methods and used to quantify differences between them. Analysis necessary to extrapolate the results of the tests to the severe lightning environment is discussed. Predicted values from computer models are compared with test results. Author

N89-13416# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
THE SEARCH AND RESCUE ADVISOR: SARA
Patrick T. W. Hudson (Leiden Univ., Netherlands) Feb. 1987 57 p
(Contract A84/KM/097)
(IZF-1987-4; TD-87-2171; ETN-88-93447) Avail: NTIS HC A04/MF A01

An expert system to help with search and rescue actions at sea is presented. The system must be capable of assessing where potential survivors are to be found, making search and rescue plans, and assessing those plans in the light of available resources and capabilities. Factors involved in developing such an expert system in LISP, and the experience of the constructor are reviewed. Documentation on the system is provided. ESA

N89-13417# Army Aeromedical Research Unit, Fort Rucker, Ala.
DISORIENTATION ACCIDENTS AND INCIDENTS IN U.S. ARMY HELICOPTERS, 1 JANUARY 1980 - 30 APRIL 1987 Final Report
P. Vyrnwy-Jones Mar. 1988 65 p
(AD-A198720; USAARL-88-3) Avail: NTIS HC A04/MF A01 CSCL 01C

Accident data was obtained from the U.S. Army Safety Center for all U.S. Army helicopter spatial disorientation accidents which occurred during the period beginning on 1 January 1980 and ending on 30 April 1987. During this time, there were 120 accidents caused by spatial disorientation which were responsible for 37 fatalities and 56 disabling injuries. Major causal factors are analyzed and recommendations made for changes in aircrew training, education and aircraft instrumentation. Also discussed are the effects of operations undertaken in hostile environments. GRA

N89-13418# Sverdrup Technology, Inc., Arnold Air Force Station, Tenn.
AN EMPIRICAL LOOK AT TOLERANCES IN SETTING ICING TEST CONDITIONS WITH PARTICULAR APPLICATION TO ICING SIMILITUDE Final Report, Apr. 1986 - Jan. 1987
C. Scott Bartlett Aug. 1988 57 p Prepared in cooperation with AEDC, Arnold AFS, Tenn.
(AD-A198941; AEDC-TR-87-23; DOT/FAA/CT-87/31) Avail: NTIS HC A04/MF A01 CSCL 01B

An investigation was conducted of the requirements for setting icing test conditions for aircraft engine certification tests. Experimental data were gathered and analyzed to determine how much each of the ice scaling parameters could be allowed to deviate from specified conditions without affecting the similarity of the ice accretions. Also studied were how changes in the ice scaling parameters and changes in the icing test conditions themselves affected the resulting ice shapes. The results indicate that: (1) icing similitude criteria must be established in advance of the test; (2) changes in the scaling parameters do not necessarily indicate a change in the ice shape; (3) experimental data are useful in determining allowable changes in the icing test conditions; (4) determination of allowable tolerances for icing test parameters will depend on which icing regime one is operating in; and (5) scaling laws used in this report cannot solely be used to determine tolerances in setting icing test conditions. GRA

N89-13419# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.
TERMINAL AREA FORECASTS: FISCAL YEARS 1988-2000
Mar. 1988 433 p
(AD-A198079; FAA-APO-88-3) Avail: NTIS HC A19/MF A01 CSCL 01E

This report contains forecasts of aviation activity for 847 airports in the United States for fiscal years 1988 to 2000. These include 399 airports with FAA air traffic control towers and radar approach control service and 14 FAA contract towers. For each airport, detailed forecasts are made for the four major users of the air traffic system: air carriers, air taxi/commuters, general aviation, and military. Summary tables contain national, FAA regional, and state aviation data and other airports specific highlights. The forecasts have been prepared to meet the budget and planning needs of the constituent units of the FAA headquarters and regional offices and to provide airport-specific information that can be used by state and local aviation authorities, the aviation industry, as a whole, and the general public. GRA

N89-13420# Electronics Research Lab., Adelaide (Australia).
LOCATING THE SOURCE OF LONG-DISTANCE RADIO DISTRESS SIGNALS FROM THE SOUTHERN OCEAN
G. L. Goodwin Mar. 1988 88 p
(AD-A198239; ERL-0449-SD; DODA-AR-005-365) Avail: NTIS HC A05/MF A01 CSCL 17C

This report summarizes a feasibility study and strategy appropriate to search and rescue operations for ships or aircraft in distress in the Southern Ocean. The use of high frequency ionospherically-propagated radio transmissions is justified. Measurement of the direction of arrival of a radio signal facilitates ray-tracing through the ionosphere Characteristics of the F2 region mid-latitude ionization trough are considered in detail. Because the trough is displaced towards Australia, its position must be known as near as practicable in real time for sufficiently accurate ray-tracing to be performed quickly enough after receipt of a distress signal. The differential Doppler technique using, for example, 150 and 400 MHz transmissions from NAVSAT (NNSS) satellites is recommended in locating the trough position. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N89-13421# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
LORAN C TSO DATA BASE Technical Note, Feb. 1987 - Jan. 1988
Jean Evans, Robert Bernheisel, Mark Dickinson, Thomas Wisser, and Martin Wortham Jun. 1988 124 p
(AD-A198975; DOT/FAA/CT-TN88/1) Avail: NTIS HC A06/MF A01 CSCL 17G

This report lists a data base for bench simulation testing aviation Loran C receivers for en route and terminal position accuracy. A set of data points was selected from Loran C stability flight tests conducted over the continental U.S. in 1984-1985 at 400 locations, 100 points in each of four Loran C chains. It may someday be used as a substitute for some of the flight testing required in an Advisory Circular or Technical Standard Order to obtain a Supplemental Type Certificate for Loran C equipment for en route and terminal aircraft operations. The report also discusses the procedures used to collect and select the data base. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N89-13422*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
STUDIES OF THE DYNAMICS OF THE TWIN-LIFT SYSTEM Interim Report, Jul. 1983 - Sep. 1987
H. C. Curtiss, Jr. Oct. 1988 63 p

(Grant NAG2-244)
(NASA-CR-183273; NAS 1.26:183273; MAE-TR-1840) Avail: NTIS HC A04/MF A01 CSCL 01C

A full set of equations of motion for the twin lift system, linearized about a hover trim condition were derived and presented. It is shown that this full set of equations of motion decouples into simpler sets of equations of motion if the aerodynamic coupling derivatives of the helicopters are neglected. One of these decoupled sets of equations of motion (referred to as the planar set) was studied at length. The other decoupled set (referred to as the nonplanar set) is examined here. It is shown that when the geometric configuration of the twin-lift is symmetric that a further decoupling is possible into antisymmetric and symmetric sets of equations. One set of these reduced equations of motion referred to as the antisymmetric set is directly equivalent to the longitudinal motion of a single helicopeter with a sling load. The second set, referred to as the symmetric set corresponds to the rotation of the entire system without load motion. As in the case of the planar symmetric motion, the location of the tether attachment point influences the stability of the nonplanar symmetric mode. The trend is opposite however in the nonplanar case in that an attachment point below the helicopter center of gravity gives a favorable effect on the stability. The effect is not as strong however as the unfavorable effect on the planar symmetric mode. Author

N89-13423*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPTIMIZATION BY DECOMPOSITION: A STEP FROM HIERARCHIC TO NON-HIERARCHIC SYSTEMS
Jaroslaw Sobieszczanski-Sobieski Sep. 1988 29 p Presented at the 2nd NASA/Air Force Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, Hampton, Va., 28-30 Sep. 1988
(NASA-TM-101494; NAS 1.15:101494) Avail: NTIS HC A03/MF A01 CSCL 01C

A new, non-hierarchic decomposition is formulated for system optimization that uses system analysis, system sensitivity analysis, temporary decoupled optimizations performed in the design subspaces corresponding to the disciplines and subsystems, and a coordination optimization concerned with the redistribution of responsibility for the constraint satisfaction and design trades among the disciplines and subsystems. The approach amounts to a variation of the well-known method of subspace optimization modified so that the analysis of the entire system is eliminated from the subspace optimization and the subspace optimizations may be performed concurrently. Author

N89-13424*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REAL-TIME FLIGHT TEST ANALYSIS AND DISPLAY TECHNIQUES FOR THE X-29A AIRCRAFT
John W. Hicks and Kevin L. Petersen Nov. 1988 20 p Presented at the 73rd Flight Test Techniques Symposium Flight Mechanics Panel, Edwards AFB, Calif., 17-20 Oct. 1988
(NASA-TM-101692; H-1520; NAS 1.15:101692; AGARD-Paper-6) Avail: NTIS HC A03/MF A01 CSCL 01C

The X-29A advanced technology demonstrator flight envelope expansion program and the subsequent flight research phase gave impetus to the development of several innovative real-time analysis and display techniques. These new techniques produced significant improvements in flight test productivity, flight research capabilities, and flight safety. These techniques include real-time measurement and display of in-flight structural loads, dynamic structural mode frequency and damping, flight control system dynamic stability and control response, aeroperformance drag polars, and aircraft specific excess power. Several of these analysis techniques also provided for direct comparisons of flight-measured results with analytical predictions. The aeroperformance technique was made possible by the concurrent development of a new simplified in-flight net thrust computation method. To achieve these levels of on-line flight test analysis, integration of ground and airborne systems was required. The capability of NASA Ames Research Center, Dryden Flight Research Facility's Western Aeronautical Test Range was a key factor in enabling implementation of these methods. Author

N89-13425# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
ROTOR SYSTEM EVALUATION, PHASE 1 Final Report, 1 Sep. - 2 Feb. 1987
Robert M. Buckanin, Warren Gould, Paul W. Losier, David A. Downey, and Roy Lockwood Mar. 1988 207 p
(AD-A198794; USAAEFA-85-15) Avail: NTIS HC A10/MF A01 CSCL 01C

Flight testing was conducted on a UH-60A Black Hawk helicopter in support of the NASA-Ames Modern Technology Rotors program to provide and validate the technology, acoustics, handling qualities and cost of civil and military rotorcraft. In cooperation with the Rotorcraft Flight Investigations Branch of NASA-Ames Research Center and the U.S. Army Aviation Research and Technology Activity, the U.S. Army Aviation Engineering Flight Activity (AEFA) conducted flight tests totalling 31 productive flight hours between 9 January and 2 June 1987. This report summarizes the flight tests accomplished, test conditions, data, and techniques used to obtain the data. Data measurements included: atmospheric and aircraft state parameters; main rotor blade structural loads, positions and accelerations; flight control positions and structural loads; main rotor hub accelerations and various vibration measurements for the aircraft cabin floor. The handling qualities data in this report, although not representative of a UH-60A in typical operating conditions, were similar to previous AEFA test results in similar configurations. The power required for level flight and hovering out-of-ground effect also agreed with previous results. GRA

N89-13426# Rensselaer Polytechnic Inst., Troy, N.Y.
THE CENTER OF EXCELLENCE IN ROTARY TECHNOLOGY AT RENSSELAER POLYTECHNIC INSTITUTE Final Report
R. G. Loewy, ed., O. Bauchau, R. Bielawa, M. Darlow, R. J. Diefendorf, R. Duffy, R. Mayle, H. Nagamatsu, M. Shephard, and S. Winckler 15 Apr. 1988 327 p
(Contract DAAG29-82-K-0093)
(AD-A198964; CERL-TR-E-88/08; ARO-19431.23-EG-RW) Avail: NTIS HC A15/MF A01 CSCL 01C

The activities associated with establishing a Center of Excellence in Rotary Wing Technology at Rensselaer Polytechnic Institute under a five year contract with the U.S. Army Research Office are reported here. These include measures taken to provide comprehensive and in-depth curricula at advanced levels in rotorcraft technology; attract and retain outstanding young people in these programs; perform basic research at the leading edge of technology in structures, structural dynamics, unsteady aerodynamics and aeroelasticity disciplines as applied to rotorcraft; developing useful new national research resources in these areas; and accomplishing technology transfer to the rotorcraft community beyond the Rensselaer campus. Descriptions, references and statistics are provided to allow assessment of the extent to which these goals have been realized. GRA

N89-13427# Boeing Advanced Systems Co., Seattle, Wash.
OPTICAL FIRE DETECTOR TESTING IN THE AIRCRAFT ENGINE NACELLE FIRE TEST SIMULATOR Final Report, Jul. 1985 - Oct. 1986
Alan M. Johnson Mar. 1988 85 p
(Contract F33615-84-C-2431)
(AD-A197974; D180-30348-1; AFWAL-TR-87-2089) Avail: NTIS HC A05/MF A01 CSCL 01C

Optical fire detector systems for aircraft engine compartments provided by fire vendors were evaluated in the Aircraft Engine

Compartment Fire Test Simulator (AENFTS). Their ability to sense JP-4 fires of two sizes and provide fire warnings in a variety of simulated flight environments was monitored along with their freedom from false fire warnings. One systems was identified which provided fire warnings for every test fire and was completely free of false alarms. GRA

N89-13428*# Sverdrup Technology, Inc., Cleveland, Ohio.
ANALYTICAL ICE SHAPE PREDICTIONS FOR FLIGHT IN NATURAL ICING CONDITIONS
Brian M. Berkowitz and James T. Riley (Federal Aviation Agency, Atlantic City, N.J.) Dec. 1988 39 p
(Contracts NAS3-24105; DTFA-03-81-A-00209)
(NASA-CR-182234; E-4547; NAS 1.26:182234; DOT/FAA/CT-88/19) Avail: NTIS HC A03/MF A01 CSCL 01C

LEWICE is an analytical ice prediction code that has been evaluated against icing tunnel data, but on a more limited basis against flight data. Ice shapes predicted by LEWICE is compared with experimental ice shapes accreted on the NASA Lewis Icing Research Aircraft. The flight data selected for comparison includes liquid water content recorded using a hot wire device and droplet distribution data from a laser spectrometer; the ice shape is recorded using stereo photography. The main findings are as follows: (1) An equivalent sand grain roughness correlation different from that used for LEWICE tunnel comparisons must be employed to obtain satisfactory results for flight; (2) Using this correlation and making no other changes in the code, the comparisons to ice shapes accreted in flight are in general as good as the comparisons to ice shapes accreted in the tunnel (as in the case of tunnel ice shapes, agreement is least reliable for large glaze ice shapes at high angles of attack); (3) In some cases comparisons can be somewhat improved by utilizing the code so as to take account of the variation of parameters such as liquid water content, which may vary significantly in flight. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N89-13429*# Toledo Univ., Ohio. Dept. of Chemical Engineering.
A COMPARISON OF NUMERICAL METHODS FOR THE PREDICTION OF TWO-DIMENSIONAL HEAT TRANSFER IN AN ELECTROTHERMAL DEICER PAD M.S. Thesis. Final Contractor Report
William B. Wright Washington NASA Dec. 1988 138 p
(Grant NAG3-72)
(NASA-CR-4202; E-4380; NAS 1.26:4202) Avail: NTIS HC A07/MF A01 CSCL 01D

Transient, numerical simulations of the deicing of composite aircraft components by electrothermal heating have been performed in a 2-D rectangular geometry. Seven numerical schemes and four solution methods were used to find the most efficient numerical procedure for this problem. The phase change in the ice was simulated using the Enthalpy method along with the Method for Assumed States. Numerical solutions illustrating deicer performance for various conditions are presented. Comparisons are made with previous numerical models and with experimental data. The simulation can also be used to solve a variety of other heat conduction problems involving composite bodies. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N89-13430# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
EARLY JET ENGINES AND THE TRANSITION FROM CENTRIFUGAL TO AXIAL COMPRESSORS: A CASE STUDY IN TECHNOLOGICAL CHANGE Ph.D. Thesis
Brian J. Nichelson 1988 257 p
(AD-A198775; AFIT/CI/NR-88-192) Avail: NTIS HC A12/MF A01 CSCL 21E

The transition from centrifugal-flow compressors to axial-flow compressors in the jet engines of the late 1940's and early 1950's provides an illuminating case study of the evolutionary nature of technological change. A look at the development of the turbojet in light of engineering design reveals that incremental changes came about in response to changing needs. The iterative nature of engineering design, whereby a designer repeats a step until he arrives at an acceptable solution, allows the designer to take into account new needs and new information. The first two turbojets, invented independently in England and Germany in the mid-1930's, both used centrifugal compressors. The inventors built upon the two hundred year-old tradition of centrifugal-flow turbomachinery to design a successful turbojet compressor. In contrast, all attempts at designing and building an axial-flow compressor prior to the twentieth century failed. Yet, researchers in four different countries persisted in their efforts because of their faith in the potential of the axial compressor to produce a higher pressure ratio at a better efficiency than the centrifugal compressor. GRA

N89-13431# Avco Lycoming Div., Stratford, Conn.
T55-L-714 ENGINE DEVELOPMENT AND QUALIFICATION: TIP CLEARANCE ANALYSIS Final Report
S. Sawdye 31 May 1988 23 p
(Contract DAAJ09-87-C-A072)
(AD-A198849; LYC-T55-88-04) Avail: NTIS HC A03/MF A01 CSCL 21E

The performance of the T55-L-714 engine has shown to be strongly influenced by gas turbine running tip clearance. In order to ensure both optimum steady state performance and to prevent rubs of the gas producer turbine upon rapid deceleration and acceleration, a steady state and transient tip clearance analysis has been conducted. GRA

N89-13432*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SENSOR FAILURE DETECTION FOR JET ENGINES
Walter C. Merrill Nov. 1988 43 p Submitted for publication
(NASA-TM-101396; E-4402; NAS 1.15:101396) Avail: NTIS HC A03/MF A01 CSCL 21E

The use of analytical redundancy to improve gas turbine engine control system reliability through sensor failure detection, isolation, and accommodation is surveyed. Both the theoretical and application papers that form the technology base of turbine engine analytical redundancy research are discussed. Also, several important application efforts are reviewed. An assessment of the state-of-the-art in analytical redundancy technology is given. Author

N89-13433*# Garrett Turbine Engine Co., Phoenix, Ariz.
THERMAL BARRIER COATING LIFE-PREDICTION MODEL DEVELOPMENT Annual Report No. 1
T. E. Strangman and J. Neumann 9 Sep. 1985 62 p
(Contract NAS3-23945)
(NASA-CR-175002; NAS 1.26:175002; Rept-21-5477) Avail: NTIS HC A04/MF A01 CSCL 21E

Life predictions are made for two types of strain-tolerant and oxidation-resistant Thermal Barrier Coating (TBC) systems produced by commercial coating suppliers to the gas turbine industry. The plasma-sprayed TBC system, composed of a low-pressure plasma spray (LPPS) applied oxidation-resistant NiCrAlY bond coating and an air-plasma-sprayed yttria (8 percent) partially stabilized zirconia insulative layer, is applied by both Chromalloy and Klock. The second type of TBC is applied by the electron-beam/physical vapor deposition process by Temescal. Thermomechanical and thermochemical testing of the program TBCs is in progress. A number of the former tests has been completed. Fracture mechanics data for the Chromalloy plasma-sprayed TBC system indicate that the cohesive toughness of the zirconia layer is increased by thermal cycling and reduced by high temperature exposure at 1150 C. Eddy current technology feasibility has been established with respect to nondestructively measuring zirconia layer thickness of a TBC system. High pressure turbine blades have been coated with program TBC systems for a piggyback test in a TFE731-5 turbofan factory engine test. Data from this test will be used to validate the TBC life models.

Author

N89-13434# Coordinating Research Council, Inc., Atlanta, Ga.
AVIATION FUEL LUBRICITY EVALUATION
Jul. 1988 212 p
(Contract DAAK70-86-C-0011)
(AD-A198197; CRC-560) Avail: NTIS HC A10/MF A01 CSCL 21D

Fuel system components have experienced problems with the slipperiness or lubricity of the fuel back to the early 1960's. As a consequence of the level of refinement necessary for the PWA 523 fuel (now designated Mil-T-38219 grade JP-7) to obtain its high-temperature stability, many of the polar compounds contributing to lubricity had been removed, resulting in abnormal hydraulic fuel pump wear. A lubricity-enhancing compound was developed (PWA 536) to eliminate the wear problem. High-pressure piston-type fuel pumps were one of the first parts of the engine fuel system to exhibit problems related to fuel properties. One early problem manifested itself as corrosion of silver-plated slipper pads and was related to carryover of residual chlorides fuel. Fuel controls were another part of the engine fuel system susceptible to fuel properties. Lack of lubricity agents caused fuel control sliding servo valves to stick. GRA

N89-13435*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
FLIGHT MEASURED AND CALCULATED EXHAUST JET CONDITIONS FOR AN F100 ENGINE IN AN F-15 AIRPLANE
Francisco J. Hernandez and Frank W. Burcham, Jr. Oct. 1988 17 p
(NASA-TM-100419; H-1449; NAS 1.15:100419) Avail: NTIS HC A03/MF A01 CSCL 20E

The exhaust jet conditions, in terms of temperature and Mach number, were determined for a nozzle-aft end acoustic study flown on an F-15 aircraft. Jet properties for the F100 EMD engines were calculated using the engine manufacturer's specification deck. The effects of atmospheric temperature on jet Mach number, M10, were calculated. Values of turbine discharge pressure, PT6M, jet Mach number, and jet temperature were calculated as a function of aircraft Mach number, altitude, and power lever angle for the test day conditions. At a typical test point with a Mach number of 0.9, intermediate power setting, and an altitude of 20,000 ft, M10 was equal to 1.63. Flight measured and calculated values of PT6M were compared for intermediate power at altitudes of 15500, 20500, and 31000 ft. It was found that at 31000 ft, there was excellent agreement between both, but for lower altitudes the specification deck overpredicted the flight data. The calculated jet Mach numbers were believed to be accurate to within 2 percent. Author

N89-13436*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
CONSTITUTIVE MODELING FOR ISOTROPIC MATERIALS Annual Report, May 1983 - Apr. 1984
V. G. Ramaswamy, R. H. VanStone, L. T. Dame, and J. H. Laflen 15 Apr. 1985 86 p
(Contract NAS3-23927)
(NASA-CR-174805; NAS 1.26:174805) Avail: NTIS HC A05/MF A01 CSCL 21E

The first year of progress on a NASA-Lewis contract with the General Electric Co is documented. The purpose of this contract (NAS3-23927) is to develop and evaluate unified constitutive equations for applications to hot-path components of aircraft gas turbine engines such as high pressure turbine blades and vanes. To accomplish this goal, uniaxial, notched, and multiaxial specimens made of conventionally cast Rene 80 are being tested under conditions that simulate engine operating conditions. To reduce the raw data, automated data reduction techniques are being developed that produce computer files containing the information needed to analyze proposed constitutive theories. Described are the analytical methods being developed to determine the parameters for these nonlinear unified theories by using the reduced data files. In another activity, a dedicated finite-element computer code is being developed to use unified theories in the structural analysis of hot-section components. This code was extensively verified for one such theory by successfully predicting the strain histories measured experimentally at the notch root of complex specimens taken from complex laboratory specimens. Author

N89-13437*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ISOLATED TESTING OF HIGHLY MANEUVERABLE INLET CON CEPTS
W. P. Norby, B. A. Haeffele (McDonnell Aircraft Co., St. Louis, Mo.), and R. R. Burley Dec. 1986 167 p
(NASA-CR-179544; NAS 1.26:179544) Avail: NTIS HC A08/MF A01 CSCL 21E

Ten percent scale models of a Mach 2.2 two dimensional inlet and a Mach 2.0 axisymmetric inlet were tested in the NASA Lewis Research Center 8'x6' Supersonic Wind Tunnel as part of a cooperative effort with the McDonnell Aircraft Company. The objective of this effort was to test methods designed to increase the maneuvering performance of fighter aircraft inlets. Maneuvering improvement concepts were tested up to 40-deg angle of attack for Mach numbers of 0.6 and 0.9, and up to 25 deg for Mach numbers 1.2 and 1.4. Maneuvering improvement concepts included a rotating cowl lip, auxiliary inlets aft of the inlet throat, and a retracting centerbody for the axisymmetric inlet. Test results show that the rotating cowl design was effective in improving subsonic maneuvering performance for both inlets. Auxiliary inlets did not produce significant performance increases for either model. The retracted centerbody resulted in some performance benefits at high angles of attack. None of the maneuvering improvement concepts were effective at Mach 1.2 and 1.4. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N89-13438*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONTROL OF A HUMAN-POWERED HELICOPTER IN HOVER
Joseph J. Totah and William Patterson (California Polytechnic State Univ., San Luis Obispo.) Nov. 1988 65 p
(NASA-TM-101029; A-88280; NAS 1.15:101029) Avail: NTIS HC A04/MF A01 CSCL 01C

The study of a control system for the Da Vinci 2 human-powered helicopter in hovering flight is documented. This helicopter has two very large, slowly rotating rotor blades and is considered to be unstable in hover. The control system is designed to introduce stability in hover by maintaining level rotors through the use of rotor tip mounted control surfaces. A five degree of freedom

kinematic model was developed to study this control system and is documented. Results of this study show that the unaugmented configuration is unstable due to the large Lock Number, and the augmented configuration is stable. The role of NASA in this study included the development and analysis of the kinematic model and control laws. Both analytical and numerical techniques were used. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N89-13439# Sandia National Labs., Albuquerque, N. Mex. Development Testing.
DEVELOPMENT TESTING AT SANDIA
Del M. Olson 1988 3 p Presented at the 59th Shock and Vibration Symposium, Albuquerque, N. Mex., 18 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-014962; SAND-88-2283C; CONF-881076-4) Avail: NTIS HC A02/MF A01

Sandia National Laboratories maintains an extensive development test capability including, but not limited to, explosive, climatic, electromagnetic, thermal, mechanical shock, vibration, and static environments. These facilities are briefly described. DOE

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N89-13440*# North Carolina State Univ., Raleigh.
MARS MISSION RESEARCH CENTER Semiannual Status Report, 1 Jun. - 1 Dec. 1988
Dec. 1988 16 p Prepared in cooperation with North Carolina Agricultural and Technical State Univ., Greensboro
(Grant NAGw-1331)
(NASA-CR-184605; NAS 1.26:184605) Avail: NTIS HC A03/MF A01 CSCL 22A

The Mars Mission Research Center is one of nine University Space Engineering Research Centers established by NASA to broaden the nation's engineering capability to meet the critical needs of the civilian space program. It has the goal of focusing on research and training technologies for planetary exploration with particular emphasis on Mars. The research combines: (1) composite materials and fabrication, (2) light weight structures and controls, and (3) hypersonic aerodynamics and propulsion in a cross disciplined program directed towards the development of the space transportation system for planetary travel. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N89-13441# California Univ., Berkeley. Lawrence Berkeley Lab.
LOW-ALTITUDE ORBITS FOR SPACE-BASED INTERCEPTORS
P. B. Duffy and C. T. Cunningham Jul. 1988 41 p
(Contract W-7405-eng-48)
(DE88-013955; UCID-21423) Avail: NTIS HC A03/MF A01

This study has two goals: The first is to quantitatively evaluate several issues concerning the positioning of space-based interceptors (SBIs) at low altitudes in response to fast-acting ICBMs. These issues are how much is performance improved with low-altitude orbits, what air-drag penalty is incurred, and can elliptical orbits be used to reduce air drag. The second goal is to use the same quantitative methods to find optimum orbit altitudes against various threats. The approach is relatively narrow: we try to identify altitudes that get the best defense performance from a given amount of rocket propellant. The study has four main conclusions. First, the performance of SBI defenses in general will not be improved much by reducing the basing altitude. Second, elliptical orbits do not save stationkeeping fuel compared to circular orbits, unless inclinations within a few degrees of 63.4 deg can be used. Third, if SBIs have more than about 90 sec to reach their targets, altitudes above approximately 400 km are the most fuel efficient, and altitudes can be raised to 500 km or higher with very little decrease in effectiveness or increase in fuel consumption. The increased survivability presumably obtained at higher altitudes should be worth the cost. Finally, SBI defenses are probably not practical if fast threats or long defense start-up delays reduce SBI flight times below about 50 sec. In this situation, conceivable options for the defense - either very low orbits or very high speed SBIs, or a very large number of SBIs - all require unreasonably large amounts of propellant. DOE

N89-13442*# Eagle Engineering, Inc., Houston, Tex.
PLANECHG: EARTH ORBIT TO LUNAR ORBIT DELTA V ESTIMATION PROGRAM. USER AND TECHNICAL DOCUMENTATION
20 Sep. 1988 103 p
(Contract NAS9-17878)
(NASA-CR-172085; NAS 1.26:172085; EEI-88-214) Avail: NTIS HC A06/MF A01 CSCL 22C

The PLANECNG computer program calculates velocities for Earth-to-Mooon and Moon-to-Earth trajectories. The flight to be analyzed originates in a circular orbit of any inclination and altitude about one of the bodies, and culminates in a circular orbit of any inclination and altitude about the other body. An intermedate delta V and plane change occurs at the Lunar Sphere of Influence (SOI), the region where the vehicle is near its lowest velocity in the trajectory, and therefore where it is able to make the plane change with the lowest delta V. A given flight may penetrate the SOI at a number of points. Each point has associated with it a unique set of delta V's and total velocity. The program displays the velocities, in matrix form, for a representative set of SOI penetration points. An SOI point is identified by projecting Lunar latitude and longitude onto the SOI. The points recorded for a given flight are defined by the user, who provides a starting longitude and latitude, and an increment for each. A matrix is built with 10 longitudes forming the columns and 19 latitudes forming the rows. This matrix is presented in six reports, each containing different velocity or node information in the body of the matrix. Author

N89-13443*# Eagle Engineering, Inc., Houston, Tex.
LLOFX EARTH ORBIT TO LUNAR ORBIT DELTA V ESTIMATION PROGRAM USER AND TECHNICAL DOCUMENTATION
Apr. 1988 44 p
(Contract NAS9-17878)
(NASA-CR-172091; NAS 1.26:172091; EEI-88-212) Avail: NTIS HC A03/MF A01 CSCL 22C

The LLOFX computer program calculates in-plane trajectories from an Earth-orbiting space station to Lunar orbit in such a way that the journey requires only two delta V burns (one to leave Earth circular orbit and one to circularize into Lunar orbit). The program requires the user to supply the Space Station altitude and Lunar orbit altitude (in km above the surface), and the desired time of flight for the transfer (in hours). It then determines and displays the trans-Lunar injection (TLI) delta V required to achieve the transfer, the Lunar orbit insertion (LOI) delta V required to circularize the orbit around the Moon, the actual time of flight, and whether the transfer orbit is elliptical or hyperbolic. Return information is also displayed. Finally, a plot of the transfer orbit is displayed. Author

N89-13444*# Eagle Engineering, Inc., Houston, Tex.
CISLUNAR PROGRAM MANUAL: A LOW-THRUST TRAJECTORY DETERMINATION MODEL
30 Sep. 1988 123 p
(Contract NAS9-17878)
(NASA-CR-172089; NAS 1.26:172089; EEI-88-209) Avail: NTIS HC A06/MF A01 CSCL 22C

CISLUNAR is a stand-alone computer program designed to generate the trajectory of a low-thrust spacecraft travelling in Earth-Moon space. The program allows the creation of functional trajectories dependent on the supplied spacecraft characteristics. The trajectory generation is a user interactive process. The original intent was for the program user to modify. the necessary control values until a staisfactory trajectory has been created. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N89-13445*# Tuskegee Inst., Ala. Dept. of Mechanical Engineering.
ARC-DRIVEN RAIL ACCELERATOR RESEARCH Final Report
Pradosh K. Ray Feb. 1987 50 p
(Grant NAG3-76)
(NASA-CR-179584; NAS 1.26:179584) Avail: NTIS HC A03/MF A01 CSCL 14B

Arc-driven rail accelerator research is analyzed by considering wall ablation and viscous drag in the plasma. Plasma characteristics are evaluated through a simple fluid-mechanical analysis considering only wall ablation. By equating the energy dissipated in the plasma with the radiation heat loss, the average properties of the plasma are determined as a function of time and rate of ablation. Locations of two simultaneously accelerating arcs were determined by optical and magnetic probes and fron streak camera photographs. All three measurements provide consistent results. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N89-13446*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSPAS-SARSAT SATELLITE ORBIT PREDICTOR, VOLUME 12 Technical Memorandum, Oct. 1988 - Apr. 1989
Morton L. Friedman Oct. 1988 107 p
(NASA-TM-85015; Rept-87B0289; NAS 1.15:85015) Avail: NTIS HC A06/MF A01 CSCL 22A

The satellite orbit predictor is a graphical aid for determining the relationship between the satellite (SARSAT or COSPAS) orbit, antenna coverage of the spacecraft, and coverage of the Local User Terminals (LUTs). The period October 16, 1988, through April 15, 1989, will be covered. Additionally, a table of equator crossings for each satellite, which contains the zulu date/time that a satellite will orbit the equator northbound, the orbit number, and the longitude that it will cross the equator, is contained. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N89-13447*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY, 1985. VOLUME 5: WORK BREAKDOWN STRUCTURE AND DICTIONARY Final Report, Jul. 1984 - Dec. 1986
James H. Nelson and Daniel R. Callan Aug. 1985 34 p Revised, July 1987
(Contract NAS8-36108)
(NASA-CR-183547; NAS 1.26:183547; MCR-86-2601-Vol-5-Rev) Avail: NTIS HC A03/MF A01 CSCL 22B

To establish consistency and visibility within the Orbital Transfer Vehicle (OTV) program, a preliminary work breakdown structure (WBS) and dictionary were developed. The dictionary contains definitions of terms to be used in conjunction with the WBS so that a clear understanding of the content of the hardware, function, and cost elements may be established. The OTV WBS matrix is a two-dimensional structure which shows the interrelationship of these dimensions: the hardware elements dimension and the phase and function dimension. The dimension of time cannot be shown graphically, but must be considered. Each cost entry varies with time so that it is necessary to know these cost values by year for budget planning and approval as well as for establishing cost streams for discounting purposes in the economic analysis. While a multiple dimensional approach may at first appear complex, it actually provides benefits which outweigh any concern. This structural interrelationship provides the capability to view and analyze the OTV costs from a number of different financial and management aspects. Cost may be summed by hardware groupings, phases, or functions. The WBS may be used in a number of dimensional or single listing format applications. Author

N89-13448*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY, 1985. VOLUME 3: SYSTEM AND PROGRAM TRADES Final Report, Jul. 1984 - Oct. 1985
James H. Nelson, Gordon W. Mohrman, and Daniel R. Callan Aug. 1986 137 p Revised, July 1987
(Contract NAS8-36108)
(NASA-CR-183546; NAS 1.26:183546; MCR-86-2601-Vol-3-Rev) Avail: NTIS HC A07/MF A01 CSCL 22B

The key system and program trade studies performed to arrive at a preferred Orbital Transfer Vehicle (OTV) system concept and evolutionary approach to the acquisition of the requisite capabilites is documented. These efforts were expanded to encompass a Space Transportation Architecture Study (STAS) mission model and recommended unmanned cargo vehicle. The most important factors affecting the results presented are the mission model requirements and selection criteria. The reason for conducting the OTV concept definition and system analyses study is to select a concept and acquisition approach that meets a delivery requirement reflected by the mission model. Author

N89-13449*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY, 1985. VOLUME 2: OTV CONCEPT DEFINITION AND EVALUATION. BOOK 2: OTV CONCEPT DEFINITION Final Report, Jul. 1984 - Oct. 1985
Glen J. Dickman and J. T. Keeley Oct. 1985 213 p Revised
(Contract NAS8-36108)
(NASA-CR-183543; NAS 1.26:183543;
MCR-86-2601-Vol-2-Bk-2-Rev) Avail: NTIS HC A10/MF A01 CSCL 22B

This portion of the Orbit Transfer Vehicle (OTV) Concept Definition and System Analysis Study, Volume 2, Book 2, summarizes the flight vehicle concept selection process and results. It presents an overview of OTV mission and system design requirements and describes the family of OTV recommended, the reasons for this recommendation, and the associated Phase C/D Program. Author

N89-13450*# Martin Marietta Aerospace, Denver, Colo.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY. VOLUME 10: AEROCAPTURE FOR MANNED MARS MISSIONS
W. H. Willcockson Jan. 1988 54 p Revised
(Contract NAS8-36108)
(NASA-CR-183550; NAS 1.26:183550; MCR-86-2601-Vol-10-Rev)
Avail: NTIS HC A04/MF A01 CSCL 22B

A manned expedition to Mars has been under consideration as a potential mission for the early 21st century. The necessarily large vehicle requirements have sparked interest in aerocapture as a means of reducing propellant usage. This volume summarizes the work performed to establish concepts and feasibility of such a mission which makes maximum use of aeroassist maneuvers. Author

N89-13451*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY, 1986. VOLUME 1-A: EXECUTIVE SUMMARY SUPPLEMENT Final Report, Jul. 1984 - Oct. 1986
Glen J. Dickman Apr. 1987 43 p Revised, July 1987
(Contract NAS8-36108)
(NASA-CR-183542; NAS 1.26:183542; MCR-87-2601-Vol-1-A-Rev)
Avail: NTIS HC A03/MF A01 CSCL 22B

This extension study has assessed the impact that the existence of a Large Cargo Vehicle and a variety of aggressive mission models would have on the preferred Orbital Transfer Vehicle Program. Author

N89-13452*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY, 1985. VOLUME 2: OTV CONCEPT DEFINITION AND EVALUATION. BOOK 4: OPERATIONS Final Report, Jul. 1984 - Oct. 1985
Jack C. Mitchell and J. T. Keeley Aug. 1985 202 p Revised, July 1987
(Contract NAS8-36108)
(NASA-CR-183545; NAS 1.26:183545;
MCR-86-2601-Vol-2-Bk-4-Rev) Avail: NTIS HC A10/MF A01 CSCL 22B

The benefits of the reusable Space Shuttle and the advent of the new Space Station hold promise for increasingly effective utilization of space by the scientific and commercial as well as military communities. A high energy reusable oribital transfer vehicle (OTV) represents an additional capability which also exhibits potential for enhancing space access by allowing more ambitious missions and at the same time reducing launch costs when compared to existing upper stages. This section, Vol. 2: Book 4, covers launch operations and flight operations. The launch operations section covers analyses of ground based and space based vehicles, launch site facilities, logistics requirements, propellant loading, space based maintenance and aft cargo carrier access options. The flight operations sections contain summary descriptions of ground based and space based OTV missions, operations and support requirements, and a discussion of fleet implications. Author

N89-13453*# Morton Thiokol, Brigham City, Utah. Aerospace Group.
DEBRIS PREVENTION ANALYSIS FOR DFI/OFI/OEI (STS-26 CONFIGURATION ONLY) Final Report
Glen A. Richi 22 Aug. 1988 16 p
(Contract NAS8-30490)
(NASA-CR-179421; NAS 1.26:179421; TWR-18091;
WBS-4B102-10-08) Avail: NTIS HC A03/MF A01 CSCL 22B

The first 3 shuttle flights to use the Redesigned Solid Rocket Motors (RSRMs) will utilize Development Flight Instrumentation (DFI), as well as Operational Flight Instrumentation (OFI), and Operational Environment Instrumentation (OEI). The OFI consists of high pressure transducers used on both RSRMs to monitor the igniter and motor chamber pressure. DFI consists of assorted strain gages, temperature sensors, accelerometers, girth gages, and low level pressure transducers. The latter are installed on the left hand booster to measure post-separation aerodynamic loading. OEI consistes of temperature sensors. After Flight 3, all DFI gages are to be deleted, and only OFI and OEI will be used for subsequent flights. This report deals specifically with debris prevention and hazards concernig the STS-26 flight DFI configuration only. Continued analysis is being done that will adequately address the debris hazards associated with the STS-27 and subsequent flight DFI configurations. Author

N89-13454*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY, 1986. VOLUME 9: STUDY EXTENSION RESULTS Final Report, Jan. - Sep. 1986
Allen E. Kofal Jul. 1987 298 p Revised
(Contract NAS8-36108)
(NASA-CR-183549; NAS 1.26:183549; MCR-87-2601-Vol-9-Rev)
Avail: NTIS HC A13/MF A01 CSCL 22B

The purpose of this extension to the OTV Concept Definition and Systems Analysis Study was to improve the definition of the OTV Program that will be most beneficial to the nation in the 1995 to 2010 timeframe. The implications of the defined mission and defined launch vehicle are investigated. The key mission requirements identified for the Space Transportation Architecture Study (STAS) were established and reflect a need for early capability and more ambitious capability growth. The key technical objectives and related issues addressed are summarized. The analyses of selected areas including aerobrake design, proximity operations, and the balance of EVA and IVA operations used in the support of the OTV at the space-base were enhanced. Sensitivity studies were conducted to establish how the OTV program should be tailored to meet changing circumstances. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N89-13455* National Aeronautics and Space Administration, Washington, D.C.
TELEMETRY: SUMMARY OF CONCEPT AND RATIONALE
Dec. 1987 57 p
(NASA-TM-101184; NAS 1.15:101184; CCSDS-100.0-G-1) Avail: NASA, Washington, D.C., Code TS CSCL 09F

This report presents the concept and supporting rationale for the telemetry system developed by the Consultative Committee for Space Data Systems (CCSDS). The concepts, protocols and data formats developed for the telemetry system are designed for flight and ground data systems supporting conventional, contemporary free-flyer spacecraft. Data formats are designed with efficiency as a primary consideration, i.e., format overhead is minimized. The results reflect the consensus of experts from many space agencies. An overview of the CCSDS telemetry system introduces the notion of architectural layering to achieve transparent and reliable delivery of scientific and engineering sensor data (generated aboard space vehicles) to users located in space or on earth. The system is broken down into two major conceptual

categories: a packet telemetry concept and a telemetry channel coding concept. Packet telemetry facilitates data transmission from source to user in a standardized and highly automated manner. It provides a mechanism for implementing common data structures and protocols which can enhance the development and operation of space mission systems. Telemetry channel coding is a method by which data can be sent from a source to a destination by processing it in such a way that distinct messages are created which are easily distinguishable from one another. This allows construction of the data with low error probability, thus improving performance of the channel. M.G.

N89-13456# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
HYPERVELOCITY ORBITAL INTERCEPT GUIDANCE Ph.D. Thesis
Salvatore Alfano 14 Apr. 1988 186 p
(AD-A197149; AFIT/Ci/NR-88-165) Avail: NTIS HC A09/MF A01 CSCL 22A

Terminal guidance of a hypervelocity exo-atmospheric orbital interceptor with free end-time is examined. The pursuer is constrained to lateral thrusting with the evader modeled as an ICBM in its final boost phase. Proportional navigation, optimal control using certainty equivalence, dual control, and control with optimum thrust spacing are all examined. Also, a new approach called certainty control is developed for this problem. This algorithm constrains the final state to a function of projected estimate error to reduce control energy expenditure. All methods model the trajectories using splines and employ eight state Extended Kalman Filters with line-of-sight and range updates. The relative effectiveness of these control strategies is illustrated by applying them to various intercept problems. GRA

N89-13457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND IMPLEMENTATION OF A MICROCOMPUTER-BASED USER INTERFACE CONTROLLER FOR BURSTED DATA COMMUNICATIONS SATELLITE GROUND TERMINALS
Mary Jo W. Shalkhauser Dec. 1988 22 p
(NASA-TM-101375; E-4428; NAS 1.15:101375) Avail: NTIS HC A03/MF A01 CSCL 09F

The NASA Lewis Research Center is developing a laboratory-based satellite communications test bed for evaluation of state-of-the-art communications hardware and systems. Most of the digital components of the ground terminals are being constructed in-house at NASA Lewis. One of the ground terminal subsystems, the user interface controller, controls the connection and disconnection of all users to the communication network. The role of the user interface controller in the ground terminal is described and the design and implementation of the microcomputer-based subsystem is discussed. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N89-13458*# Martin Marietta Aerospace, Denver, Colo.
ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY. VOLUME 2: OTV CONCEPT DEFINITION AND EVALUATION. BOOK 3: SUBSYSTEM TRADE STUDIES
Glen J. Dickman Jul. 1987 431 p Revised
(Contract NAS8-36108)
(NASA-CR-183544; NAS 1.26:183544; MCR-86-2601-Vol-2-Bk-3-Rev) Avail: NTIS HC A19/MF A01 CSCL 22B

The technical trade studies and analyses reported in this book represent the accumulated work of the technical staff for the contract period. The general disciplines covered are as follows: (1) Guidance, Navigation, and Control; (2) Avionics Hardware; (3) Aeroassist Technology; (4) Propulsion; (5) Structure and Materials; and (6) Thermal Control Technology. The objectives in each of these areas were to develop the latest data, information, and analyses in support of the vehicle design effort. Author

N89-13459* National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION SYSTEMS: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 6)
Jul. 1988 294 p
(NASA-SP-7056(06); NAS 1.21:7056(06)) Avail: NTIS HC A13 CSCL 22B

This bibliography lists 1,133 reports, articles, and other documents introduced into the NASA scientific and technical information system between July 1, 1987 and December 31, 1987. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems. The coverage includes documents that define major systems and subsystems, servicing and support requirements, procedures and operations, and missions for the current and future Space Station. Author

N89-13460*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROCEEDINGS OF THE 4TH ANNUAL SCOLE WORKSHOP
Lawrence W. Taylor, Jr., comp. Oct. 1988 383 p Workshop held in Colorado Springs, Colo., 16 Nov. 1987
(NASA-TM-101503; NAS 1.15:101503) Avail: NTIS HC A17/MF A01 CSCL 22B

This publication is a collection of papers presented at the Fourth Annual Spacecraft Control Laboratory Experiment (SCOLE) Workshop held at the U.S.A.F. Academy, Colorado Springs, Colorado, November 16, 1987. The papers address the modeling, systems identification, and control synthesis for the Spacecraft Control Laboratory Experiment (SCOLE) configuration. For individual titles, see N89-13461 through N89-13476.

N89-13461*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
PARAMETER IDENTIFICATION USING MODAL DATA
L. Meirovitch and M. A. Norris *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 1-15 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

Parameter identification using experimental modal data is examined. The following approaches are discussed: (1) Direct - using actual sensor measurements to obtain parameters (e.g., ERA, ITD); and (2) Indirect - identifies parameters using measured modal data. In this work, only the natural frequencies are used to identify physical parameters. Author

N89-13462*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
INFINITE-DIMENSIONAL APPROACH TO SYSTEM IDENTIFICATION OF SPACE CONTROL LABORATORY EXPERIMENT (SCOLE)
S. A. Hossain and K. Y. Lee *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 17-53 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

The identification of a unique set of system parameters in large space structures poses a significant new problem in control

technology. Presented is an infinite-dimensional identification scheme to determine system parameters in large flexible structures in space. The method retains the distributed nature of the structure throughout the development of the algorithm and a finite-element approximation is used only to implement the algorithm. This approach eliminates many problems associated with model truncation used in other methods of identification. The identification is formulated in Hilbert space and an optimal control technique is used to minimize weighted least squares of error between the actual and the model data. A variational approach is used to solve the problem. A costate equation, gradients of parameter variations and conditions for optimal estimates are obtained. Computer simulation studies are conducted using a shuttle-attached antenna configuration, more popularly known as the Space Control Laboratory Experiment (SCOLE) as an example. Numerical results show a close match between the estimated and true values of the parameters. Author

N89-13463*# California Univ., Los Angeles. Dept. of Electrical Engineering.
SOME NONLINEAR DAMPING MODELS IN FLEXIBLE STRUCTURES
A. V. Balakrishnan *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 54-66 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

A class of nonlinear damping models is introduced with application to flexible flight structures characterized by low damping. Approximate solutions of engineering interest are obtained for the model using the classical averaging technique of Krylov and Bogoliubov. The results should be considered preliminary pending further investigation. Author

N89-13464*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NONLINEARITIES IN SPACECRAFT STRUCTURAL DYNAMICS
Larry Taylor and Kelly Latimer (Department of the Air Force, Washington, D.C.) *In its* Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 67-101 Prepared in cooperation with George Washington Univ., Washington, D.C. (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

In considering nonlinearities in spacecraft structural dynamics, the following are examined: (1) SCOLE Configuration-Equations of Motion; (2) Modeling Error Sources; (3) Approximate Solutions; (4) Comparison of Model Accuracy; (5) Linear and Nonlinear Damping; (6) Experimental Results; and, (7) Future Work Author

N89-13465*# Ohio State Univ., Columbus.
CONTROL DESIGN APPROACHES FOR LaRC EXPERIMENTS
Steve Yurkovich and Umit Ozguner *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 103-122 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

Control design approaches for SCOLE experimentation at Langley Research Center are considered; the following future topics are discussed: (1) Effects of Actuator Dynamics; (2) Refinement of STAC; (3) System Identification; and (4) Experimentation. Author

N89-13466*# Howard Univ., Washington, D. C. Dept. of Mechanical Engineering.
STABILITY ANALYSIS OF LARGE SPACE STRUCTURE CONTROL SYSTEMS WITH DELAYED INPUT
A. S. S. R. Reddy and Peter M. Bainum *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 123-132 Presented at the 6th VPI and SU/AIAA Symposium on Dynamics and Control of Large Structures (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

Large space structural systems, due to their inherent flexibility and low mass to area ratio, are represented by large dimensional mathematical models. For implementation of the control laws for such systems a finite amount of time is required to evaluate the control signals; and this time delay may cause instability in the closed loop control system that was previously designed without taking the input delay into consideration. The stability analysis of a simple harmonic oscillator representing the equation of a single mode as a function of delay time is treated analytically and verified numerically. The effect of inherent damping on the delay is also analyzed. The control problem with delayed input is also formulated in the discrete time domain. Author

N89-13467*# Howard Univ., Washington, D. C. Dept. of Mechanical Engineering.
THE DYNAMICS AND CONTROL OF THE IN-ORBIT SCOLE CONFIGURATION
Peter M. Bainum, A. S. S. R. Reddy, Cheick Modibo Diarra, and Feiyue Li *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 145-180 (For primary document see N89-13460 05-18)
(Grant NsG-1414)
Avail: NTIS HC A17/MF A01 CSCL 22B

The study of the dynamics of the Spacecraft Control Laboratory Experiment (SCOLE) is extended to emphasize the synthesis of control laws for both the linearized system as well as the large amplitude slewing maneuvers required to rapidly reorient the antenna line of sight. For control of the system through small amplitude displacements from the nominal equilibrium position LQR techniques are used to develop the control laws. Pontryagin's maximum principle is applied to minimize the time required for the slewing of a general rigid spacecraft system. The minimum slewing time is calculated based on a quasi-linearization algorithm for the resulting two point boundary value problem. The effect of delay in the control input on the stability of a continuously acting controller (designed without considering the delay) is studied analytically for a second order plant. System instability can result even for delays which are only a small fraction of the natural period of motion. Author

N89-13468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INITIAL TEST RESULTS ON STATE ESTIMATION ON THE SCOLE MAST
D. Sparks, Jr. *In its* Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 181-191 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

Modal state estimation tests are performed on the SCOLE mast for the fixed Shuttle platform case. Kalman filter state estimation results from a five mode computer model of the SCOLE mast, developed from a finite element analysis, are compared with those state estimates obtained from laboratory tests. Two comparison runs are presented, one an excitation of the first two bending modes, another, an excitation of the first torsional mode of the mast. Results from both runs show poor agreement in modal estimation between the computer model simulations and the laboratory test data. At present, the reason(s) for this poor performance is unknown. Both the laboratory hardware and software and the computer model are being checked for possible sources of errors. Further computer simulations as well as laboratory testing will be performed. Author

N89-13469*# Control Research Corp., Lexington, Mass.
SLEWING AND VIBRATION CONTROL OF THE SCOLE
Jiguan Gene Lin *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 193-215 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

A discussion of Slewing and Vibration Control makes the following conclusions: (1) A 2-stage approach is feasible and promising for rapid slewing and precision pointing of SCOLE; (2) Not all bang-bang type of time-minimized slew maneuvers will excite large structural vibrations in SCOLE; and (3) Modal dashpots can be a concentrated high-power vibration control, as well as

the usual diffuse (broadband, low-power (low-authority) control. The following recommendations are made: (1) Limit the magnitude of applied forces on reflector to either the 25-lb limit of vernier thrusters on the real Space Shuttle or the 150-lb level equivalent to the cold-gas jets of laboratory SCOLE; (2) to complete stage 2, add an integrated design of LQF/LTR (Linear-Quadratic-Gaussian/Loop-Transfer Recovery) and Modal Dashpots; and, (3) Validate the 2-stage approach using the SCOLE laboratory facility with a comprehensive sequence of integrated designs and experiments coupling nonlinear rigid-body motions with flexible-body dynamics. Author

N89-13470*# Purdue Univ., West Lafayette, Ind.
PLACING DYNAMIC SENSORS AND ACTUATORS ON FLEXIBLE SPACE STRUCTURES
Gregory A. Norris and Robert E. Skelton *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 217-257 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

Input/Output Cost Analysis involves decompositions of the quadratic cost function into contributions from each stochastic input and each weighted output. In the past, these suboptimal cost decomposition methods of sensor and actuator selection (SAS) have been used to locate perfect (infinite bandwidth) sensor and actuators on large scale systems. This paper extends these ideas to the more practical case of imperfect actuators and sensors with dynamics of their own. NASA's SCOLE examples demonstrate that sensor and actuator dynamics affect the optimal selection and placement of sensors and actuators. Author

N89-13471*# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
OPTIMIZATION-BASED DESIGN OF CONTROL SYSTEMS FOR FLEXIBLE STRUCTURES
E. Polak, T. E. Baker, T-L. Wuu, and Y-P. Harn *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 259-290 (For primary document see N89-13460 05-18)
(Contract N00014-86-K-0295; AF-AFOSR-0116-86; NSF ECS-85-17362)
Avail: NTIS HC A17/MF A01 CSCL 22B

The purpose of this presentation is to show that it is possible to use nonsmooth optimization algorithms to design both closed-loop finite dimensional compensators and open-loop optimal controls for flexible structures modeled by partial differential equations. An important feature of our approach is that it does not require modal decomposition and hence is immune to instabilities caused by spillover effects. Furthermore, it can be used to design control systems for structures that are modeled by mixed systems of coupled ordinary and partial differential equations. Author

N89-13472*# Naval Research Lab., Washington, D.C.
EFFECT OF ACTUATOR DYNAMICS ON CONTROL OF BEAM FLEXURE DURING NONLINEAR SLEW OF SCOLE MODEL
Shalom Fisher *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 291-307 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

The effect of actuator dynamics on the control of beam flexure during nonlinear slewing of the SCOLE model is discussed. Two aspects of physical limitations on the regulation of beam flexure are similated, i.e., (1) a one foot travel limitation of displacement of proof-mass actuators; and (2) a time delay of 0.1 secs. in application of controls. The goal was to assess the magnitude of induced errors and, comparing the results to the ideal, and to determine how much flexure there is during slew and settling. Author

N89-13473*# North Carolina Univ., Charlotte. Dept. of Electrical Engineering.
COMBINED PROBLEM OF SLEW MANEUVER CONTROL AND VIBRATION SUPPRESSION
Y. P. Kakad *In* NASA, Langley Research Center, Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 309-320 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

The combined problem of slew maneuver control and vibration suppression of NASA Spacecraft Control Laboratory Experiment (SCOLE) is considered. The coupling between the rigid body modes and flexible modes together with the effect of the control forces on the flexible antenna is discussed. The nonlinearities in the equations are studied in terms of slew maneuver angular velocities. Author

N89-13474*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ROBUST MODEL-BASED CONTROLLER SYNTHESIS FOR THE SCOLE CONFIGURATION
E. S. Armstrong, S. M. Joshi, and E. J. Stewart (George Washington Univ., Hampton, Va.) *In its* Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 321-327 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

The design of a robust compensator is considered for the SCOLE configuration using a frequency-response shaping technique based on the LQG/LTR algorithm. Results indicate that a tenth-order compensator can be used to meet stability-performance-robustness conditions for a 26th-order SCOLE model without destabilizing spillover effects. Since the SCOLE configuration is representative of many proposed spaceflight experiments, the results and design techniques employed potentially should be applicable to a wide range of large space structure control problems. Author

N89-13475*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYTIC REDUNDANCY MANAGEMENT FOR SCOLE
Raymond C. Montgomery *In its* Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 329-345 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

The objective of this work is to develop a practical sensor analytic redundancy management scheme for flexible spacecraft and to demonstrate it using the SCOLE experimental apparatus. The particular scheme to be used is taken from previous work on the Grid apparatus by Williams and Montgomery. Author

N89-13476*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A MATHEMATICAL PROBLEM AND A SPACECRAFT CONTROL LABORATORY EXPERIMENT (SCOLE) USED TO EVALUATE CONTROL LAWS FOR FLEXIBLE SPACECRAFT. NASA/IEEE DESIGN CHALLENGE
Lawrence W. Taylor, Jr. and A. V. Balakrishnan (California Univ., Los Angeles.) *In its* Proceedings of the 4th Annual SCOLE Workshop Oct. 1988 p 347-373 (For primary document see N89-13460 05-18)
Avail: NTIS HC A17/MF A01 CSCL 22B

The problen of controlling large, flexible space systems has been evaluated using computer simulation. In several cases, ground experiments have also been used to validate system performance under more realistic conditions. There remains a need, however, to test additional control laws for flexible spacecraft and to directly compare competing design techniques. A program is discussed which has been initiated to make direct comparisons of control laws for, first, a mathematical problem, then and experimental test article being assembled under the cognizance of the Spacecraft Control Branch at the NASA Langley Research Center with the advice and counsel of the IEEE Subcommittee on Large Space Structures. The physical apparatus will consist of a softly supported dynamic model of an antenna attached to the Shuttle by a flexible

beam. The control objective will include the task of directing the line-of-sight of the Shuttle antenna configuration toward a fixed target, under conditions of noisy data, control authority and random disturbances. Author

N89-13477# Interferometrics, Inc., Vienna, Va.
THE DETERMINATION OF NAVSPASUR PHASE DIFFERENCE ERRORS
E. J. Wadiak and Michael D. Andrews 16 Mar. 1988 52 p
(Contract N00014-87-C-2547)
(AD-A198859) Avail: NTIS HC A04/MF A01 CSCL 17A

This paper describes the methodology and results of a project to determine the magnitude and amplitude dependence of the errors inherent in the full-Doppler mode NAVSPASUR phase difference data. The purpose of this work was to generate an accurate model of these errors for subsequent use in simulation programs designed to predict the performance capabilities of both the current NAVSPASUR system and various proposed upgrades. We report here on the preliminary results obtained from an analysis of full-Doppler mode data collected by the NAVSPASUR system during one four hour period. The fundamental NAVSPASUR measured quantity is the received signal phase at each antenna array at a given receiver site. The raw phases from each of the n antenna arrays at a receiver site are combined to produce n-1 phase differences, each taken with respect to the designated reference antenna. The deployment of antenna arrays along each of two orthogonal directions, together with the use of antenna pairs (hereafter baselines) with different spatial separations (baseline lengths), allows for the simultaneous determination of two direction cosines (cos alpha, where alpha is the angle between the baseline vector and the satellite position vector in station coordinates) at each receiving site. GRA

N89-13478# Interferometrics, Inc., Vienna, Va.
COHERENT COMBINATION OF SIGNALS FROM MULTIPLE RECEIVING SITES OF NAVSPASUR (NAVAL SPACE SURVEILLANCE)
David B. Shaffer and Michael D. Andrews 10 Jun. 1988 9 p
(Contract N00014-87-C-2547)
(AD-A198871) Avail: NTIS HC A02/MF A01 CSCL 17K

The Naval Space Surveillance system (NAVSPASUR) is designed to determine orbits for satellites which reflect signals from the NAVSPASUR transmitters. There are several NAVSPASUR receiving sites, each of which has 11 or 12 individual antennas. The relative phase of reflected signals as received at these closely spaced antennas (typically within 200 to 1200 feet of each other) is used to determine the angular location of the satellites. Because of the short baselines between the antennas, the accuracy of an angular position measurement is not high. Typical accuracies are 0.01 degree. If it were possible to combine signals from several NAVSPASUR sites (with typical separations of many hundreds to thousands of kilometers), much higher position accuracies could potentially be determined. It might also be expected that some imaging information could be gained for some larger satellites. This report discusses the requirements for coherent combination of signals received at different NAVSPASUR sites, and notes the limits set by equipment, propagation effects, and the characteristics of the NAVSPASUR signals themselves. By coherent combination, we mean determining the relative phases of signals received at different sites. We conclude that little useful information is likely to result from such operation, mostly because it is unlikely that accurate, absolute phases can be determined. GRA

N89-13479# RADEX, Inc., Carlisle, Mass.
PRELIMINARY DOCUMENTATION OF THE MACH (MESOTHERMAL AURORAL CHARGING) CODE Scientific Report No. 1, Mar. - Dec. 1987
M. F. Tautz, D. C. Cooke, A. G. Rubin, and G. K. Yates 18 Dec. 1987 86 p
(Contract F19628-87-C-0084)
(AD-A198921; RX-871218; AFGL-TR-88-0035) Avail: NTIS HC A05/MF A01 CSCL 12E

This report documents the input and output considerations for the computer code MACH, and the analytical models incorporated therein. Actual FORTRAN and C coding is not given. MACH has been designed to study Mesothermal Auroral Charging, and other problems requiring a self-consistent steady-state solution of Poisson's equation with precise kinetic transport of charged particles. The solution space is two dimensional (axisymmetric) in configuration space, and three dimensional in velocity space. MACH code features include: limited object definition capability; Poisson's solution by hybrid SOR; stationary or drifting Maxwellian plasma; and a collisionless Vlasov approximation to particle transport, solved by a reverse trajectory inside-out method augmented with a velocity space topology search algorithm. GRA

N89-13480# National Oceanic and Atmospheric Administration, Washington, D. C. Office of Systems Development
GVAR USERS COMPENDIUM, VOLUME 1
Keith McKenzie, ed. and Raymond J. Komajda, ed. (Mitre Corp., McLean, Va.) May 1988 206 p
(PB88-241476; NOAA-TM-NESDIS-21-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 22B

The compendium is a collection of exerpts from a variety of documents that were produced during the development of the GOES I-M spacecraft and ground systems. The information contained herein ranges from technical background material on the spacecraft instruments to the current detailed plans for operations once GOES I becomes operational. GRA

N89-13481* National Aeronautics and Space Administration, Washington, D.C.
TECHNOLOGY FOR LARGE SPACE SYSTEMS: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 19)
Nov. 1988 145 p
(NASA-SP-7046(19); NAS 1.21:7046(19)) Avail: NTIS HC A07 CSCL 22B

This bibliography lists 526 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1, 1988 and June 30, 1988. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems. Author

N89-13482*# Bionetics Corp., Hampton, Va.
SYSTEM DESIGN ANALYSES OF A ROTATING ADVANCED-TECHNOLOGY SPACE STATION FOR THE YEAR 2025 Interim Report, Nov. 1987 - May 1988
M. J. Queijo, A. J. Butterfield, W. F. Cuddihy, R. W. Stone, J. R. Wrobel, P. A. Garn, and C. B. King Dec. 1988 250 p
(Contract NAS1-18267)
(NASA-CR-181668; NAS 1.26:181668) Avail: NTIS HC A11/MF A01 CSCL 22B

Studies of an advanced technology space station configured to implement subsystem technologies projected for availability in the time period 2000 to 2025 is documented. These studies have examined the practical synergies in operational performance available through subsystem technology selection and identified the needs for technology development. Further analyses are performed on power system alternates, momentum management and stabilization, electrothermal propulsion, composite materials and structures, launch vehicle alternates, and lunar and planetary missions. Concluding remarks are made regarding the advanced technology space station concept, its intersubsystem synergies, and its system operational subsystem advanced technology development needs. Author

N89-13483*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESULTS OF EVA/MOBILE TRANSPORTER SPACE STATION TRUSS ASSEMBLY TESTS
Judith J. Watson, Walter L. Heard, Jr., Harold G. Bush, M. S.

Lake, J. K. Jensen, R. E. Wallsom, and J. E. Phelps (PRC Kentron, Inc., Hampton, Va.) Nov. 1988 31 p
(NASA-TM-100661; NAS 1.15:100661) Avail: NTIS HC A03/MF A01 CSCL 22B

Underwater neutral buoyance tests were conducted to evaluate the use of a Mobile Transporter concept in conjunction with EVA astronauts to construct the Space Station Freedom truss structure. A three-bay orthogonal tetrahedral truss configuration with a 15 foot square cross section was repeatedly assembled by a single pair of pressure suited test subjects working from the Mobile Transporter astronaut positioning devices (mobile foot restraints). The average unit assembly time (which included integrated installation of utility trays) was 27.6 s/strut, or 6 min/bay. The results of these tests indicate that EVA assembly of space station size structures can be significantly enhanced when using a Mobile Transporter equipped with astronaut positioning devices. Rapid assembly time can be expected and are dependent primarily on the rate of translation permissible for on-orbit operations. The concept used to demonstate integrated installation of utility trays requires minimal EVA handling and consequentially, as the results show, has little impact on overall assembly time. Author

N89-13484*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLAR ARRAY FLIGHT EXPERIMENT Final Report
Apr. 1986 279 p
(Contract NAS8-31352)
(NASA-CR-183535; NAS 1.26:183535; LMSC-F087173) Avail: NTIS HC A13/MF A01 CSCL 22B

Emerging satellite designs require increasing amounts of electrical power to operate spacecraft instruments and to provide environments suitable for human habitation. In the past, electrical power was generated by covering rigid honeycomb panels with solar cells. This technology results in unacceptable weight and volume penalties when large amounts of power are required. To fill the need for large-area, lightweight solar arrays, a fabrication technique in which solar cells are attached to a copper printed circuit laminated to a plastic sheet was developed. The result is a flexible solar array with one-tenth the stowed volume and one-third the weight of comparably sized rigid arrays. An automated welding process developed to attack the cells to the printed circuit guarantees repeatable welds that are more tolerant of severe environments than conventional soldered connections. To demonstrate the flight readiness of this technology, the Solar Array Flight Experiment (SAFE) was developed and flown on the space shuttle Discovery in September 1984. The tests showed the modes and frequencies of the array to be very close to preflight predictions. Structural damping, however, was higher than anticipated. Electrical performance of the active solar panel was also tested. The flight performance and postflight data evaluation are described.
Author

N89-13485# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
SPACECRAFT ENVIRONMENTAL ANOMALIES EXPERT SYSTEM Status Report
H. C. Koons and D. J. Gorney 1 Dec. 1988 115 p
(Aerospace-ATR-88(9562)-1) Avail: NTIS HC A06/MF A01

A microcomputer based expert system is being developed to assist in the diagnosis of satellite anomalies caused by the space environment. The expert system is designed to address anomalies caused by surface charging, bulk charging, single event effects, and total radiation dose. These effects depend on the orbit of the satellite, the local environment (which is highly variable), the satellite exposure time, and the hardness of the circuits and components of the satellite. The expert system is a rule-based system that uses the Texas Instrument Personal Consultant Plus expert system shell. The completed expert system knowledge base will include 150 to 200 rules, as well as a spacecraft attributes database, a historical spacecraft anomalies database, and a space environment database which is updated in near real time. Currently, the expert system is undergoing development and testing. The status of the expert system development completed in FY88 is reviewed. Author

N89-13486*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN INTEGRATED IN-SPACE CONSTRUCTION FACILITY FOR THE 21ST CENTURY
Martin M. Mikulas, Jr. and John T. Dorsey Nov. 1988 31 p
(NASA-TM-101515; NAS 1.15:101515) Avail: NTIS HC A03/MF A01 CSCL 22B

Preliminary results are presented of studies being conducted by NASA on the construction of very large spacecraft. The various approaches are discussed for constructing spacecraft and their relative merits. It is observed that the Space Station Freedom has all of the basic design characteristics to permit its growth into an in-space construction facility for very large spacecraft. Also it is noted that if disturbances from construction operations are intolerable to other Space Station experiments, a co-orbiting construction facility could be built using previously developed Space Station truss hardware and systems. A discussion is also presented of a new PATHFINDER research initiative on on-orbit construction. This research effort is aimed at developing construction methods for very large spacecraft and includes the development of a 100 meter long space crane. Author

N89-13487*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE VERSATILITY OF A TRUSS MOUNTED MOBILE TRANSPORTER FOR IN-SPACE CONSTRUCTION
Harold G. Bush, Mark S. Lake, Judith J. Watson, and Walter L. Heard, Jr. Nov. 1988 19 p
(NASA-TM-101514; NAS 1.15:101514) Avail: NTIS HC A03/MF A01 CSCL 22B

The Mobile Transporter (MT) evolution from early erectable structures assembly activities is detailed. The MT operational features which are required to support astronauts performing on-orbit structure construction or spacecraft assembly functions are presented and discussed. Use of the MT to perform a variety of assembly functions is presented. Estimated EVA assembly times for a precision segmented reflector approximately 20 m in diameter are presented. The EVA/MT technique under study for construction of the reflector (and the entire spacecraft) is illustrated. Finally, the current status of development activities and test results involving the MT and Space Station structural assembly are presented. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N89-13488*# Quantic Industries, San Carlos, Calif.
LONG-LIFE 3-AXIS SATELLITE ATTITUDE SENSING, PHASE 1 Final Report
Tor Arild 31 Aug. 1987 34 p
(Contract NAS5-30055)
(NASA-CR-180793; NAS 1.26:180793; ER-817) Avail: NTIS HC A03/MF A01 CSCL 14B

The purpose was to investigate the feasibility of new, moderate-cost, high reliability navigation sensors for high-altitude satellites, using stellar sources to obviate the use of gyroscopic devices. The primary investigation focused on the need for developing a star tracker model to replace an old star tracker which is still needed for current probe and satellite programs. One innovative element of the proposed star tracker was the design, development, and testing of technology components related to a phase scrambler plate. The purpose of the phase scrambler plate is to convert the impulse response of the optical system from a point image to a uniformly bright, square, angularly large, in-focus image of the star source. A collimated star source was built and tested. A breadboard star tracker with an 8 x 8 degree field of view was designed and built. It was tested in normal

quad-cell mode (without the phase scrambler plate) and with the phase scrambler plate. Although the phase scrambler plate was crudely made, the performance of the star tracker breadboard was greatly improved using the phase scrambler plate, instead of system defocus. If further developed, the phase scrambler plate may be added as a low-cost retroconversion to any objective lens to greatly improve quad-cell or CCD array tracking; applications include star trackers, laser metrology, laser machining optics, and surveying instrumentation. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N89-13489*# Atlantic Research Corp., Gainesville, Va. Propulsion Div.

BLOCK 2 SOLID ROCKET MOTOR (SRM) CONCEPTUAL DESIGN STUDY, VOLUME 1 Final Report

31 Dec. 1986 191 p

(Contract NAS8-37295)

(NASA-CR-179050; NAS 1.26:179050; TR-PL-12126-Vol-1)

Avail: NTIS HC A09/MF A01 CSCL 21H

Segmented and monolithic Solid Rocket Motor (SRM) design concepts were evaluated with emphasis on joints and seals. Particular attention was directed to eliminating deficiencies in the SRM High Performance Motor (HPM). The selected conceptual design is described and discussed. B.G.

N89-13490# National Technical Systems, Long Beach, Calif.

HOLOGRAPHIC SOLAR ENERGY CONCENTRATORS FOR SOLAR THERMAL ROCKET ENGINES Final Report, Jun. 1987 - Mar. 1988

K. Renk, Y. Jacques, C. Felts, and A. Chovit May 1988 44 p

(Contract F04611-87-C-0045)

(AD-A198807; NTS-6006; AFAL-TR-88-025) Avail: NTIS HC A03/MF A01 CSCL 21H

This is a report on Holographic Concentrators for Solar Thermal Rocket Engines. The object of the work was to demonstrate that highly reflective holograms could be used as solar concentrators to heat liquid hydrogen for use as a propellant in satellite boost engines. The interest in this results from the need for a reliable, inexpensive alternate for conventional rockets. GRA

N89-13491# Ogden Air Logistics Center, Hill AFB, Utah. Propellant Analysis Lab.

LGM-30B STAGE 2 DISSECTED MOTOR TEST REPORT Annual Report, 1 Jan. - 31 Dec. 1988

Elizabeth M. Dalaba Jun. 1988 141 p

(AD-A198854; MAKPDB-538(88)) Avail: NTIS HC A07/MF A01 CSCL 21H

This report contains data from second time testing of a dissected Minuteman 2 Stage 2 motor, S/N 0022123. Statistical statements are based on F and student t tests. Data have been shown on multi-regression plots for reference only. These plots show the position of the current data relative to the prior testing of this motor and other motors. Plots have been made to show differences between blocks and slices of propellant, both unconditioned and conditioned. There are unexplained differences between the two test periods, as well as differences between conditioned and unconditioned specimens. GRA

N89-13492*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

POWER CONSIDERATIONS FOR AN EARLY MANNED MARS MISSION UTILIZING THE SPACE STATION

Martin E. Valgora [1987] 15 p Presented at Case for Mars 3, Boulder, Colo., 18-22 Jul. 1987; sponsored by American Aeronautical Society, JPL, Los Alamos National Lab., Ames Research Center, Lyndon B. Johnson Space Center, George C. Marshall Space Flight Center, Planetary Society

(NASA-TM-101436; E-4472; NAS 1.15:101436) Avail: NTIS HC A03/MF A01 CSCL 10B

Power requirements and candidate electrical power sources were examined for the supporting space infrastructure for an early (2004) manned Mars mission. This two-year mission (60-day stay time) assumed a single six crew piloted vehicle with a Mars lander for four of the crew. The transportation vehicle was assumed to be a hydrogen/oxygen propulsion design with or without large aerobrakes and assembled and checked out on the LEO Space Station. The long transit time necessitated artificial gravity of the crew by rotating the crew compartments. This rotation complicates power source selection. Candidate power sources were examined for the Lander, Mars Orbiter, supporting Space Station, co-orbiting Propellant Storage Depot, and alternatively, a co-orbiting Propellant Generation (water electrolysis) Depot. Candidates considered were photovoltaics with regenerative fuel cells or batteries, solar dynamics, isotope dynamics, and nuclear power. Author

N89-13493*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Engine Business.

EVALUATION OF COATED COLUMBIUM TEST PANELS HAVING APPLICATION TO A SECONDARY NOZZLE EXTENSION FOR THE RL10 ROCKET ENGINE SYSTEM, PARTS 1 AND 2 Final Report

Kenneth S. Murphy and Joaquin H. Castro Dec. 1988 135 p

(Contracts NAS3-25052; NAS3-24238; NAS3-24738)

(NASA-CR-180809; NAS 1.26:180809) Avail: NTIS HC A07/MF A01 CSCL 21H

The activity performed on the screening and evaluation of various coatings for application on columbium alloy test panels representative of a radiation-cooled nozzle extension for the RL10 rocket engine is summarized. Vendors and processes of candidate coatings were evaluated. Post engine test evaluations of the two selected coatings are discussed. B.G.

N89-13494*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

STS-26 SOLID ROCKET BOOSTER POST FLIGHT STRUCTURAL ASSESSMENT

David A. Herda and Charles J. Finnegan Nov. 1988 20 p

(NASA-TM-100344; NAS 1.15:100344) Avail: NTIS HC A03/MF A01 CSCL 21H

A post flight assessment of the Space Shuttle's Solid Rocket Boosters was conducted at the John F. Kennedy Space Center in Florida after the launch of STS-26. The two boosters were inspected for structural damage and the results of this inspection are presented. Overall, the boosters were in good condition. However, there was some minor damage attributed to splash down. Some of this damage is a recurring problem. Explanations of these problems are provided. Author

N89-13495*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MODELING OF IMPULSIVE PROPELLANT REORIENTATION

John I. Hochstein, Alfredo E. Patag (Washington Univ., St. Louis, Mo.), and David J. Chato [1988] 24 p Presented at the 27th Aerospace Sciences Meeting, Reno, Nev., 9-12 Jan. 1989; sponsored by AIAA

(Grant NAG3-578)

(NASA-TM-101440; E-4545; NAS 1.15:101440; AIAA-89-0628)

Avail: NTIS HC A03/MF A01 CSCL 21H

The impulsive propellant reorientation process is modeled using the (Energy Calculations for Liquid Propellants in a Space Environment (ECLIPSE) code. A brief description of the process and the computational model is presented. Code validation is documented via comparison to experimentally derived data for small scale tanks. Predictions of reorientation performance are presented for two tanks designed for use in flight experiments

and for a proposed full scale OTV tank. A new dimensionless parameter is developed to correlate reorientation performance in geometrically similar tanks. Its success is demonstrated. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

N89-13496*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOW DIELECTRIC FLUORINATED POLY(PHENYLENE ETHER KEYTONE) FILM AND COATING Patent Application
Patrick E. Cassidy, inventor (to NASA), Gordon L. Tullos, inventor (to NASA) (Southwest Texas State Univ., San Marcos.), and Anne K. StClair, inventor (to NASA) 23 Sep. 1988 16 p
(NASA-Case-LAR-13992-1-CU; NAS 1.71:LAR-13992-1-CU; US-Patent-Appl-SN-248009) Avail: NTIS HC A03/MF A01 CSCL 07A

The present invention relates to film and coating materials prepared from novel fluorinated poly(phenylene ether ketones). A fluorinated poly(phenylene ether ketone) is prepared by reacting a bisphenol with 1,1,1,3,3,3-hexafluoro-2,2-bis 4-(4-halobenzoyl) phenyl propane (wherein halo is fluoro or chloro), which is a novel monomer formed as the reaction product of halobenzene (wherein halo is fluoro or chloro) and 1,1,1,3,3,3-hexafluoro-2,2-bis (p-chloro formyl phenyl) propane. Especially beneficial results of this invention are that films and coating materials prepared from the novel fluorinated poly(phenylene ether ketone) are essentially optically transparent/colorless and have a lower dielectric constant than otherwise comparable, commercially available poly(phenylene ether ketones). Moreover, unlike the otherwise comparable commercially available materials, the novel fluorinated poly (phenylene ether ketones) of the present invention can be solution cast or sprayed to produce the films and coatings. Furthermore, the long term thermal stability of the polymers of the present invention is superior to that of the commercially available materials. NASA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N89-13497 Texas Univ., Austin.
A STUDY ON THE MEASUREMENTS OF RESIDUAL STRESSES AT THE INTERFACES OF ALUMINUM-GRAPHITE COMPOSITES AND SILICON FILM ON QUARTZ Ph.D. Thesis
Yong-moo Cheong 1987 196 p
Avail: Univ. Microfilms Order No. DA8806305

In order to quantitatively determine the residual stresses at the interfaces of composite materials measurements using laser Raman microprobe for laminate composites, and X-ray diffraction for graphite fiber reinforced aluminum metal matrix composite were performed. For the Raman microprobe method, the Raman band shift due to applied stress was calibrated using strain gages on quartz plates. A model involving exponential strain gradient in the substrate and no strain gradient in the film was developed. The measurements of residual strains at the silicon/quartz interfaces using the Raman microprobe were compared to expected residual strains by the model. The recrystallization process of silicon film by thermal annealing was also investigated using Raman spectroscopy. For aluminum film on quartz tensile residual stresses were subsequently observed at the interfaces of the quartz plates with aluminum-aluminum oxide. Lower residual stresses of the pitch-based graphite fiber reinforced aluminum matrix composites were measured by X-ray diffraction when compared to the calculated values. Dissert. Abstr.

N89-13498 Texas Univ., Austin.
IN SITU ANALYSIS OF THE BONDING OF IMPURITIES IN METAL-IMPURITY-METAL LAMINATE COMPOSITES Ph.D. Thesis
Enrique V. Barrera 1987 203 p
Avail: Univ. Microfilms Order No. DA8806290

It is proposed that the chemical nature of impurities in relation to impurities at metal-metal interfaces can be studied by means of extended X-ray absorption fine structure (EXAFS) spectroscopy. In this research metal-impurity-metal (MIM) samples of Ni-Ti-Ni, Co-Ti-Co, Al-Ga-Al, and Al-As-Al were produced by various techniques and in a number of sample conditions to obtain impurity interface conditions by which their local structure can be identified. Impurity interface thicknesses ranged from partial to 5 monolayers. Additional samples of Ti and Ni foils, TiO2-anatase and rutile powders, amorphous Ti oxide, Nitinol powder, arsenic powder, AlSi, and As in glass were analyzed under EXAFS spectroscopy. Samples were further characterized by Auger electron spectroscopy and X-ray diffraction. Dissert. Abstr.

N89-13499 Maryland Univ., College Park.
DISLOCATION DENSITY AND HIGH TEMPERATURE CREEP OF ALUMINUM ALLOYS AND FRACTURE OF SILICON CARBIDE-ALUMINUM COMPOSITES Ph.D. Thesis
Chia-Ray Feng 1987 122 p
Avail: Univ. Microfilms Order No. DA8808546

A two part investigation was undertaken to determine the correlation between dislocation density and mechanical behavior. For high temperature creep, the relationship between logarithm of strain rate and stress is divided into a linear (power law) and a nonlinear (power law breakdown) region. To explain this phenomenon an investigation was conducted. In the case of 100 Al and Al-11 wt pct Zn alloys strained at high temperature, it was found that the dislocation density, as determined by RMS micro-strain measurement and transmission electron microscopy techniques, was independent of stress in the power law region. However, it increased with stress in the power law breakdown region. Therefore, high temperature creep behavior is greatly influenced by near surface dislocation sources, with a significant increasing dislocation density. SiC reinforced Al composite material showed high strength and low toughness, the fracture having both brittle and ductile characteristics, and the fracture mechanism was controlled by the Al matrix. An investigation was undertaken to determine the causes of the changes in the reinforced matrix. The presence of SiC changes the microstructure of the Al matrix and has strongly affected Al behavior. Dissert. Abstr.

N89-13500# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. JAPAN: 12TH COMPOSITE MATERIALS SYMPOSIUM
23 Sep. 1988 93 p Transl. into ENGLISH of proceedings of Daijunikai Fukugo, Zairyo Symposium (Koen Yoshishu), Tokyo Japan, 1987 Symposium held in Tokyo, Japan, 22-23 Oct. 1987; sponsored by the Japan Composite Materials Society, Japan Machinery Society, Japan Metal Society, Japan Aerospace Society, Japan Materials Society, and Reinforced Plastics Society
(JPRS-JST-88-021) Avail: NTIS HC A05/MF A01

Selected articles presented at the 12th Composite Materials Symposium held 22 to 23 October 1987 in Tokyo are presented. The design and analysis of carbon fiber reinforced plastic laminated cylinders, the continuous forming of carbon/thermoplastic composite beams, the compressive strength of fiber reinforced composite materials, and the hot-press forming of multifilament fiber reinforced metals are among the topics discussed. For individual titles, see N89-13501 through N89-13513.

N89-13501# Joint Publications Research Service, Arlington, Va.
DESIGN, ANALYSIS OF HYBRID LAMINATED CYLINDER
Yoshifumi Nakano and Akiko Nakazono *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 1-8 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Tokyo, Japan), 22-23 Oct.

1987 p 31-34 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

With the use of carbon fiber reinforced plastic (CFRP) structural materials in many fields in recent years, design and analysis technologies making maximum use of orthotropic characteristics have become important. In this research, the basic structural element was a cylinder, easily formable, for which analytic software was developed. An outline is given of the software and examples of thermal stress and bending analysis are given. Author

N89-13502# Joint Publications Research Service, Arlington, Va.
INSPECTION OF CFRP BY INDUSTRIAL X-RAY CT SCANNER
c38
Mineo Maruoka, Hideki Ohashi, and Masashi Fujii *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 9-14 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 47-50 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

X-ray fluorography and ultrasonic methods were utilized as nondestructive methods to inspect carbon fiber reinforced plastic (CFRP) structural parts. However, these methods proved to be insufficient for evaluating the internal condition of three-dimensional shaped parts such as the CFRP joint and the pipe joint. An industrial CT scanner capable of detecting the shape, internal defects, dimensions, etc., by nondestructive inspection was used in this research, and its application to CFRP parts was studied. Author

N89-13503# Joint Publications Research Service, Arlington, Va.
SIMULATION OF BRAIDING OF THREE-DIMENSIONAL COMPOSITE
Atsushi Yokoyama, Hidemitsu Kobayashi, H. Hamada, and Zenichiro Maekawa *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 15-21 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 87-90 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

A mechanism simulation program of a cord braid was prepared, and the simulation of various braid structures was conducted with the object of designing a braid structure by using a computer. A simulation method computing the initial condition of a textile with a braiding angle set in advance was developed by controlling the braiding angle. An estimation of the critical braiding angle was made by considering carefully the fiber thickness. As one application, a simulation was conducted to obtain the conditions necessary for producing a braid with a uniform braiding angle on a special shaped cross-sectional cylinder in which the diameter was not fixed in the longitudinal direction. Also, studies were conducted on a new braiding structure aimed at producing a braid with complicated sections that differed from the conventional braiding structure. Author

N89-13504# Joint Publications Research Service, Arlington, Va.
CONTINUOUS FORMING OF CARBON/THERMOPLASTICS COMPOSITE BEAMS
Yoshiaki Sakatani, Yasuhiro Yamaguchi, and Mikine Yoshida *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 22-25 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 91-92 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

The continuous forming method of thin, long structural elements with a view to applications for future large-sized space structures is now being developed. Using a band plate shaped material of high elasticity type carbon fiber/PEEK, studies have been conducted on the basic processing conditions for passing it between rolls in stages and continuously forming it into a hat shape. Optimum forming conditions such as the optimum forming temperature and optimum speed have been ascertained by gaining an understanding of formability data on materials from the forming tests conducted by the basic testing machines and from quality evaluation of the formed materials. Author

N89-13505# Joint Publications Research Service, Arlington, Va.
MATERIAL CHARACTERIZATION OF CF/AF HYBRID FABRIC LAMINATES
Hideaki Kasano, Masataka Kawamura, and Hiroyuki Matsumoto *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 26-34 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 101-104 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

In this research, investigators tried to evaluate the fracture toughness value of carbon fiber/aramid fiber hybrid fabric laminates from the viewpoint of fracture mechanics together with ascertaining the tensile and flexural elastic constraints, fracture strain, fracture stress, etc. These experimental results were compared with the results that could be estimated from the appropriate compounding rules and laminating theory. Studies were made of various characteristics and special features brought about by the hybridization. Author

N89-13506# Joint Publications Research Service, Arlington, Va.
COMPRESSIVE STRENGTH OF FIBER REINFORCED COMPOSITE MATERIALS
Akihito Kitano, Toshiaki Morita, and Kenichi Noguchi *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 35-44 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 125-128 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

Researchers measured the compressive strength of composite materials comprised of various inorganic and organic fibers and have studied the relationship between the fiber characteristics and the compressive strength of composite materials. They also measured the compressive strength of the fiber itself in various inorganic and organic fibers by means of the torsional elastic modulus and loop method related to the structural characteristics of fibers. Author

N89-13507# Joint Publications Research Service, Arlington, Va.
TESTING OF SiC PARTICLE REINFORCED Al ALLOY
Toshiyasu Furuta, Susumu Ushigome, and Tomomi Soeda *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 45-50 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 149-152 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

Researchers mixed SiC particles and A6061 atomized powder to produce round bar and plate-shaped Al alloys reinforced with Si particles by means of hot extrusion. Sectional shapes such as round, tube, H, Z, T, etc., could be optionally selected by changing the die. The characteristics (tension, high-temperature tension, compression, wear) obtained are discussed. Although the tensile elastic modulus, tensile strength, and compressive elastic modulus increased together with the V sub f increase of the reinforcing particle SiC, the compressive strength did not rise to the extent of the modulus of elasticity. The high-temperature tensile test showed that it had a strength of 55 percent at a temperature of 200 C and a strength of 25 percent at 300 C compared with the room temperature strength. In the abrasion test, the specific abrasion of SiC V sub f equals 10 percent was about 10 percent in 3.8 m/sec as compared with the A6061 simple substance. Author

N89-13508# Joint Publications Research Service, Arlington, Va.
SiC CONTINUOUS FIBER REINFORCED ALUMINUM PREFORM WIRE
Yoshikazu Imai, Hiroshi Ichikawa, and Youichi Nagata *In its*

JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 51-58 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 157-160 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

The aim was to use the SiC continuous fiber Nicalon as the reinforcing material and to develop a compounded wire rod using Al as the matrix. The trial produced wire was Al-5.79 percent Ni, the fiber V sub f was 50 percent, and the tensile strength at both room temperature and high temperature was about 1.65 GPa. The matrix structure of this system showed a fine fibrous or lamelliform eutectic structure. It was concluded that the Nicalon Al system composite wire is a practical intermediate material (preform) for producing a high-performance fiber reinforced metal.
Author

N89-13509# Joint Publications Research Service, Arlington, Va.
HOT-PRESS FORMING OF MULTIFILAMENT FIBER REINFORCED METALS
Akira Sakamoto and Chikara Fujiwara *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 59-63 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 161-164 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

A hybrid material comprised of 0 degree/90 degree angle ply material and titanium alloy was formed for the purpose of improving the 90 degree direction strength (90 degree strength) against the fiber direction, together with studying the hot pressing process on the material system of C/Al, SiC(pcs)/Al and SiC(CVD)/Al. The mechanical characteristics of these compacts were studied and evaluated.
Author

N89-13510# Joint Publications Research Service, Arlington, Va.
TENSILE PROPERTIES OF MATRIX COMPOSITES BY HIP PROCESS
Kenichi Aota and Takashi Motoda *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 64-70 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 165-168 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

The effects of fiber matrix alloys on the strength of fiber reinforced metal (FRM) compacts formed by the HIP forming method by combining various CVD fibers and titanium alloys were studied. It was found that a higher strength was available in the SiC(CVD) fiber than in the B/(CVD) and B/B sub 4C(CVD) fibers, and that it was advantageous to use a high strength matrix as there was no great difference in the forming efficiency among the matrix alloys. At the same time, it was demonstrated that the HIP forming method was useful in the forming of FRM.
Author

N89-13511# Joint Publications Research Service, Arlington, Va.
FABRICATION METHOD OF SiC WHISKER REINFORCED Al COMPOSITES
Akira Sakamoto, Hideto Hasegawa, and Makoto Senda *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 71-77 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 169-172 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

Development of liquid infiltration and extrusion processes has been promoted on SiC whisker/Al system fiber reinforced metals (FRM). Defects caused by cluster-shaped whiskers, lump-shaped special objects, etc., occurring in the production of whiskers or defects such as shrinkage porosity generated during liquid infiltration molding remain after extrusion molding in FRM of this system, and they are the main causes of lowering the strength characteristic of FRM. Measures such as the refining of whiskers and liquid phase HIP treatment of the liquid infiltration compacts were studied as means for solving these defects, and the basis of a liquid infiltration and extrusion forming technology was established for FRM of this system.
Author

N89-13512# Joint Publications Research Service, Arlington, Va.
STRENGTH PROPERTIES OF SiC-Al COMPOSITES FABRICATED BY HP
Sotohiro Takabayashi *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 78-82 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 173-176 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

Since aluminum that has compounded whiskers has a high specific strength and excels in impact resistance characteristics in comparison with FRP, expectations are harbored for it as a future structural material. In this research, the compounding of the SiC whiskers and 2014 aluminum alloy was accomplished by hot pressing. The high-temperature flexural strength characteristics were studied. Whiskers were unidirectionally oriented by extrusion molding, and the tensile strength and thermal expansion characteristics were investigated.
Author

N89-13513# Joint Publications Research Service, Arlington, Va.
EVALUATION OF FRM HIGH-TEMPERATURE TENSILE STRENGTH
Kazumi Hirano and Tsutomu Sasaki *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 83-89 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 177-180 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

In this research, studies were conducted on matters related to the fracture mechanism in the mechanical properties of unidirectional continuous fiber reinforced metals, and aimed at the development and standardization of performance evaluation technologies such as the evaluation standard and characteristic testing method of fiber reinforced metals. The reinforced fibers submitted to room temperature and high-temperature tensile tests were carbon fibers, carbon silicide fibers and Nicalon fibers. The matrix metals included aluminum alloys and titanium alloys.
Author

N89-13514*# National Aeronautics and Space Administration, Washington, D.C.
COMPOSITION DEPENDENCE OF THE M, TEMPERATURE IN THE BETA'NiAl COMPOUND
Shouichi Ochiai and Manabu Ueno Sep. 1988 19 p Transl. into ENGLISH from Nippon Kinzoku Gahhaishi (Japan), v. 52, no. 2, 1988 p 157-162 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20336; NAS 1.77:20336) Avail: NTIS HC A03/MF A01 CSCL 11D

Martensitic transformation start (M sub s) temperatures were measured for Ni-Al sintered alloys containing 36 to 38 at. percent Al by using an electric resistivity method. The composition dependence was investigated by using a statistical approach involving the Bragg-Williams approximation. A linear relation exists between M sub s temperature and Al content and has a slope of 160 K/at percent Al. There is no difference in composition dependence of the M sub s temperature between the sintered and cast alloys. The interaction parameter between Ni and Al atoms in the martensitic phase is estimated at -12.7 kJ/mol. The composition dependence is closely related to the interaction parameters in the parent and martensitic phases and temperature dependence of the differences in the Gibbs free energy of constituent elements between the Al(fcc) and A2(bcc) crystal structure.
Author

N89-13515# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THE ADHESIVE BONDING OF THERMOPLASTIC COMPOSITES Periodic Report No. 5, Jan. - Jul. 1988
A. J. Kinloch and G. K. Kodokian 14 Jul. 1988 8 p
(Contract DAJA45-86-C-0037)
(AD-A198689; R/D-5553-MS-01) Avail: NTIS HC A02/MF A01 CSCL 11I

After exposing the composites to corona discharge treatment, the crack ran either in the adhesive in a cohesive mode or in the composite in an interlaminar mode. To understand these two types of crack propagation, various techniques have been adopted. Failure stresses of the composites have been quantified using butt joints and these values have been compared with finite element analysis (FEA) predictions. There was good correlation between the two sets of data, i.e., when the stress in the composite predicted from FEA was higher than the measured failure stress from a butt joint experiment the crack propagated in the composite. GRA

N89-13516# Southwest Research Inst., San Antonio, Tex.
MICROMECHANISMS OF FATIGUE CRACK GROWTH AND FRACTURE TOUGHNESS IN METAL MATRIX COMPOSITES Technical Report, 31 Oct. 1987 - 31 Jul. 1988
D. L. Davidson Aug. 1988 25 p
(Contract N00014-85-C-0206)
(AD-A198694; SWRI-06-8602/4) Avail: NTIS HC A03/MF A01 CSCL 11D

Fatigue crack rate data for large cracks in 12 variations of particulate silicon carbide SiC reinforced alloy composites have been measured. Composites with seven different matrix alloys were tested, four of which were of precipitation hardening compositions, and these were tested in both as-extruded and peak aged conditions. Five of the materials were made by casting, ingot metallurgical methods and two of the alloys by mechanical alloying, powder metallurgical methods. For both manufacturing methods, primary fabrication was followed by hot extrusion. GRA

N89-13517# Israel Atomic Energy Commission, Yavneh. Nuclear Research Centre.
SPALLATION AND DYNAMIC FRACTURE AS AN EFFECT OF LASER INDUCED SHOCK WAVES Interim Report No. 3, Jan. - Jun. 1988
Irith Gilath and Shalom Eliezer 22 Jun. 1988 18 p
(Contract DAJA45-87-C-0032)
(AD-A198763; R/D-5528-MS-01) Avail: NTIS HC A02/MF A01 CSCL 20K

A high irradiance single beam short pulsed Nd: glass laser was used to generate shock waves in 2D carbon-carbon composites. Dynamic brittle fracture at ultra high strain rate was observed as a result of reflected shock waves as tensile waves from the back surface of samples. Successive stages of damage from incipient spallation to complete sample perforation were obtained by increasing gradually the laser energy. The thermo-mechanical damage on the front surface as a result of laser interaction with the target material, and the mechanical damage at the back surface as a result of shock wave reflection were characterized by optical and scanning electron microscopy. The failure properties of the composites were related to the processing of densification and graphitization mode. GRA

N89-13518# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
MICROYIELD BEHAVIOR OF CARBON FIBER REINFORCED EPOXY
E. G. Wolff 1 Jun. 1988 15 p
(ATR-86(8468)-4) Avail: NTIS HC A03/MF A01

A theory for the prediction of creep and microyield strength of composite laminates with viscoelastic matrices was developed and tested. Precise, short term, creep curves from three laminates with arbitrary orientations provide the necessary input data. The time dependent lamina properties are derived for subsequent use with standard laminate codes. Both the level and shape of creep and strain recovery curves can be predicted. Extensions of the theory to include nonlinear viscoelastic matrices and the effects of microcracking are possible. Author

N89-13519# Ohio State Univ., Columbus. Research Foundation.
CUMULATIVE DAMAGE MODELLING IN COMPOSITE LAMINATES Final Report, 1 Jul. 1986 - 31 Dec. 1987
Ranbir S. Sandhu, Robert L. Sierakowski, and William E. Wolfe 29 Feb. 1988 43 p
(Grant AF-AFOSR-0211-86; AF Proj. 2917)
(AD-A198282; OSURF-718444-88-1; AFOSR-88-0903TR) Avail: NTIS HC A03/MF A01 CSCL 11D

Acquisition of laboratory equipment to enhance the capability of The Ohio State University for testing specimens and interrogating damage in advanced composite materials is described. The Air Force Equipment Grant complemented the support provided by The Ohio State University Office of Research and Graduate Studies and the College of Engineering. The report lists the equipment purchased under the AFOSR Grant as well as delineates the overall capability for advanced materials research made possible through the combined efforts of The Ohio State University and the Air Force. GRA

N89-13520# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
CRAZING IN POLYMERIC AND COMPOSITE SYSTEMS Annual Technical Report, 15 Mar. 1987 - 14 Mar. 1988
C. C. Hsiao 30 Apr. 1988 89 p
(Grant AF-AFOSR-0143-87; AF Proj. 2302)
(AD-A198372; AFOSR-88-0779TR) Avail: NTIS HC A05/MF A01 CSCL 11D

The study of the failure of composite systems under stress is important both theoretically and practically. This program aims to develop time dependent theories for studying crazing behavior of stressed polymeric and composite systems. Certain microstructural characteristics developed during deformation are considered in the mathematical formulations. This includes the development of basic analytical tools in creating possible constitutive modeling of thermo-mechanical behavior of polymeric and composite systems at combined micro- and macrostructural levels. This noncontinuum craze-crack transition is based on mesomechanical considerations which yield information upon damage micromechanics of crazing and failure behavior of polymeric and composite systems. GRA

N89-13521*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRACTURE TOUGHNESS COMPUTATIONAL SIMULATION OF GENERAL DELAMINATIONS IN FIBER COMPOSITES
T. E. Wilt, P. L. N. Murthy (Cleveland State Univ., Ohio.), and C. C. Chamis 1988 19 p Presented at the 29th Structural Dynamics and Materials Conference, Williamsburg, Va., 18-20 Apr. 1988; sponsored in part by AIAA, ASME, AHS and ASC Previously announced as A88-32219
(NASA-TM-101415; E-4513; NAS 1.15:101415) Avail: NTIS HC A03/MF A01 CSCL 11D

A procedure is described to computationally simulate composite laminate fracture toughness in terms of strain energy release rate. It is also used to evaluate the degradation in laminate structural integrity in terms of displacements, loss in stiffness, loss in vibration frequencies and loss in buckling resistance. Specific laminates are selected for detail studies in order to demonstrate the generality of the procedure. These laminates had center delaminations, off-center delaminations, and pocket delaminations (center and off-center) at the free-edge and center delaminations at the interior. The laminates had two different thicknesses and were made from three different materials. The results obtained are presented in graphical form to illustrate the effects of delamination on the laminate structural integrity and on the laminate strain energy release rate (composite fracture toughness). Author

N89-13522*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A NASTRAN DMAP ALTER FOR LINEAR BUCKLING ANALYSIS UNDER DYNAMIC LOADING
Robert A. Aiello and Joseph E. Grady [1988] 16 p Proposed for presentation at the 17th NASTRAN User's Colloquium, San Antonio, Tex., 24-28 Apr. 1989; sponsored by the Computer Software Management and Information Center (COSMIC)
(NASA-TM-100832; E-4022; NAS 1.15:100832) Avail: NTIS HC A03/MF A01 CSCL 11D

A unique modification to the NASTRAN solution sequence for transient analysis with direct time integration (COSMIC NASTRAN rigid format 9) was developed and incorporated into a DMAP alter. This DMAP alter calculates the buckling stability of a dynamically loaded structure, and is used to predict the onset of structural buckling under stress wave loading conditions. The modified solution sequence incorporates the linear buckling analysis capability (rigid format 5) of NASTRAN into the existing Transient solution rigid format in such a way as to provide a time dependent eigensolution which is used to assess the buckling stability of the structure as it responds to the impulsive load. As a demonstration of the validity of this modified solution procedure, the dynamic buckling of a prismatic bar subjected to an impulsive longitudinal compression is analyzed and compared to the known theoretical solution. In addition, a dynamic buckling analysis is performed for the analytically less tractable problem of the localized dynamic buckling of an initially flawed composite laminate under transverse impact loading. The addition of this DMAP alter to the transient solution sequence in NASTRAN facilitates the prediction of both time and mode of buckling. Author

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N89-13523# National Bureau of Standards, Gaithersburg, Md. Center for Analytical Chemistry.
STANDARD REFERENCE MATERIALS: STANDARDIZATION OF pH MEASUREMENTS (1988 EDITION)
Y. C. Wu, W. F. Koch, and R. A. Durst Feb. 1988 60 p
(PB88-217427; NBS/SP-260/53; LC-75-619344) Avail: NTIS HC A04/MF A01; also available SOD HC $2.75 as 003-003-02850-9 CSCL 07D

One of the most widely performed analytical measurements in chemical labs is that of the pH using the glass electrode. In order to ensure the consistency of these measurements, the National Bureau of Standards (NBS) recommends an operational scale of pH, maintained in terms of the pH(S) of a series of standard solutions. Certified samples of buffer materials, from which the standard reference solutions of reproducible pH can be prepared, as well as solutions in the case of rainwater, are issued by NBS as Standard Reference Materials. The report is concerned primarily with a discussion of the method used at NBS for the assignment of pH(S) values to these standard solutions, a description of the NBS measurement facilities for pH, and a summary of the characteristics of the buffer materials. A brief discussion of the types of electrodes used and the calibration of pH instrumentation is also presented. GRA

N89-13524# National Bureau of Standards, Gaithersburg, Md. Center for chemical Engineering.
CALCULATION OF CRITICAL POINTS BY THE METHOD OF HELDEMANN AND KHALIL
Brian E. Eaton Mar. 1988 53 p
(PB88-217419; NBS/TN-1313) Avail: NTIS HC A04/MF A01; also available SOD HC $2.75 as 003-003-02867-3 CSCL 07D

The formulation of critical point criteria by Heidemann and Khalil is analyzed and contrasted with the original formulation of Gibbs. An extension to the solution technique originally used by Heidemann and Khalil, and later improved by Michelson and Heidemann, is presented along with its detailed implementation for a general two-constant cubic equation of state. Finally, FORTRAN software developed for these computations is carefully documented. GRA

N89-13525# Fraunhofer Inst. fuer Kurzzeitdynamik, Freiburg im Breisgau (West Germany).
ELECTRICAL IGNITION OF HAN-BASED LIQUID PROPELLANTS Interim Report No. 4, Oct. 1987 - Mar. 1988
Guenter Klingenberg 1 Apr. 1988 12 p
(Contract DAJA45-86-C-0029)
(AD-A195094; R/D-5329-AN) Avail: NTIS HC A03/MF A01 CSCL 19A

The scope of the study is to investigate and optimize the electrical ignition of hydroxylammonium nitrate (HAN) based liquid monopropellants (LP) in conjunction with its use as a propellant charge in the regenerative liquid propellant gun (RLPG). In this research, the fundamentals of LP ignition will be investigated, which will contribute to the design of electrical igniter devices suitable for large caliber RLPG systems. Specific goals are outlined. Author

N89-13526# University of Northern Illinois, De Kalb. Dept. of Chemistry.
INVESTIGATION OF THE INTERFACE BETWEEN TWO IMMISCIBLE ELECTROLYTES APPLIED TO MEMBRANE ELECTROCHEMISTRY Progress Report, 15 Oct. 1987 - 1 Jul. 1988
Petr Vanysek 27 Jun. 1988 5 p
(Contract N00014-88-K-0075; RR04108)
(AD-A197212; Rept-36-6008480) Avail: NTIS HC A02/MF A01 CSCL 06D

The interface between two immiscible electrolytes is used as a simple model for a biological membrane. Electrochemistry of liquid-liquid interfaces allows us to gain an insight into the kinetics on membranes, adsorption processes, ion-selective electrodes and the structure of the interfacial double-layer. In this project, the following problems are especially investigated: The effects of biologically active materials on simple ion transfer kinetics, potential sensitive fluorescence dyes in liquid/liquid electrochemistry, and properties of a microinterface formed between two immiscible electrolytes. A solvent system used in our experiment was water/nitrobenzene, with LiCl as a supporting electrolyte for aqueous phase and tetrabutylammonium tetraphenylborate (TBATPB) as a supporting electrolyte for the nonaqueous phase. A water soluble protein bovine serum albumin (BSA) has been added to aqueous phase to study its adsorption effect on the liquid/liquid interface. GRA

N89-13527*# National Aeronautics and Space Administration, Washington, D.C.
RECENT DEVELOPMENT OF SURFACE MODIFICATION PROCESSING
N. Yasunaga, T. Miyazaki, and S. Miyake Sep. 1988 16 p Transl. into ENGLISH from Seimitsu Kogaku Kaishi (Japan), v. 53, no. 10, 1987 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20326; NAS 1.77:20326) Avail: NTIS HC A03/MF A01 CSCL 07D

A review with 4 references is given on the formation of superhard thin films, e.g., diamond, cubic BN, by dry processes (e.g., chemical vapor deposition, physical vapor deposition, diffusion). Author

N89-13528*# National Aeronautics and Space Administration, Washington, D.C.
DESIGN STUDY FOR MEASUREMENT OF NEUTRAL HYDROGEN ATOM DENSITY BY LASER INDUCED FLUORESCENCE METHOD
Toshihiko Yamauchi, Hiroaki Ogawa, Reiji Yamada, and Takeshi

Fukuda Sep. 1988 36 p Transl. into ENGLISH of Japan Atomic Energy Research Inst., Mar. 1987 25 p Original language document was announced as N88-11114 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20331; NAS 1.77:20331; JAERI-M-87-045) Avail: NTIS HC A03/MF A01 CSCL 07D

A system is designed to measure the fluorescence light emitted from the transitions 1S-2P of L sub alpha line (lambda=1215 A) or 2P-2S or 2P-3D of H sub alpha line (lambda=6563 A), excited by the laser induced fluorescence method. The signal-to-noise ratio (S/N) is evaluated at the measurement in the parameter (n-bar sub e = 10 to the 12th to 10 to the 14th per cu. cm, T sub e = 10 eV - 1 KeV) of tokamak plasma. The light paths in JFT-2M and JT-60 tokamaks are proposed. Author

N89-13529# Dayton Univ., Ohio.
DYNAMIC COMBUSTION STUDIES USING ADVANCED OPTICAL DIAGNOSTICS. VOLUME 1: EXPERIMENTAL STUDIES Final Report, 21 Feb. 1983 - 20 Oct. 1987
D. R. Ballal, T. H. Chen, A. J. Lightman, W. J. Schmoll, and P. P. Yaney Jul. 1988 231 p
(Contract F33615-82-C-2255)
(AD-A198685; UDR-TR-88-01; AFWAL-TR-88-2034-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 21B

Computer models of turbulent mixing and combustion suffer from many limitations, deficiencies, and errors. To evaluate and refine them, an experimental research program was started: (1) to develop a combustion test facility and optical diagnostics, (2) to perform turbulent mixing and combustion experiments, and (3) to provide a database for modeling needs. This final report describes the combustion test facility and the optical instrumentation, namely a Laser Doppler Anemometer (LDA), and a Laser Raman/Rayleigh Spectroscopy (LRS) system. The problem areas, error analysis, and data reproducibility of these optical techniques are discussed. GRA

N89-13530# Indiana Univ., Bloomington. Dept. of Chemistry.
THE DETECTION OF NEGATIVE IONS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY
Gary M. Hieftje, George H. Vickers, and Daniel A. Wilson 11 Jul. 1988 26 p
(Contract N00014-86-K-0366)
(AD-A198727; INDU/DC/GMH/TR-88-29) Avail: NTIS HC A03/MF A01 CSCL 07D

The analytical utility of negative-ion detection is evaluated for the determination of nonmetals by inductively coupled plasma-mass spectrometry. The background spectrum is simpler than for positive ions although the baseline background level is a factor of 50 times higher. The only elemental species that can be detected with reasonable sensitivity as negative ions are the halogens. For these ions, calibration curves are linear over at least four orders of magnitude and detection limits range from 10 to 400 ng/mL. Other characteristics that are evaluated include isotope ratios, matrix effects caused by the associated cation or the anion speciation, and polyatomic-ion formation. GRA

N89-13531# Oklahoma State Univ., Stillwater. Dept. of Chemistry.
THEORETICAL STUDIES OF THE CHEMICAL DYNAMICS OF UNIMOLECULAR PROCESSES Final Report, 1 Jun. 1985 - 31 May 1988
Donald L. Thompson 19 Jul. 1988 22 p
(Contract DAAG29-85-K-0039)
(AD-A198795; ARO-22238.19-CH) Avail: NTIS HC A03/MF A01 CSCL 07D

The purpose of this research program was to develop computational methods and carry out calculations to investigate the chemical dynamics of large molecules of interest as energetic materials. Classical dynamics studies were made of the intramolecular vibrational energy redistribution and unimolecular reactions in a wide variety of polyatomic molecules, including benzene, toluene, dimethylnitramine, hydrogen peroxide, HONO, and methyl nitrite. These studies are described in this report. GRA

N89-13532# Naval Research Lab., Washington, D.C.
INFRARED SPECTROSCOPIC STUDY OF Cl2/O2 CO-ADSORPTION ON Al(111) Technical Report No. 6, Oct. 1986 - Sep. 1987
V. M. Bermudez and A. S. Glass 1 Aug. 1988 14 p Submitted for publication
(AD-A198826) Avail: NTIS HC A03/MF A01 CSCL 07B

Fourier-transform infrared reflection-absorption spectroscopy (FT-IRRARS) has been used to observe the effects of Cl2(O2) pre-adsorption on the vibrational modes of O (Cl) formed by exposure of Al (111) to O2 (Cl2). On clean Al, Cl at surface sites gives rise to a stretching mode at 745 to 760/cm (depending on coverage), and a second band at 820/cm is tentatively assigned to subsurface Cl. Exposure to O2 either before or after Cl2 leads ultimately to a single broad band at a frequency intermediate to those for exposure of the clean surface to either Cl2 or O2. The results indicate strong coupling between Al-O and Al-Cl modes and suggest that the two species are intimately mixed during co-adsorption. GRA

N89-13533# Pittsburgh Univ., Pa. Surface Science Center.
A NEW MECHANISM FOR HYDROGEN DESORPTION FROM COVALENT SURFACES: THE MONOHYDRIDE PHASE ON Si(100)
Kumar Sinniah, Michael G. Sherman, Lisa B. Lewis, W. H. Weinberg, John T. Yates, Jr., and K. C. Janda 12 Aug. 1988 20 p Submitted for publication
(Contract N00014-82-K-0280)
(AD-A198842; TR-18) Avail: NTIS HC A03/MF A01 CSCL 07D

A new mechanism for the thermal desorption of molecular hydrogen from the monohydride phase on Si(100) has been identified. The unusual first-order desorption kinetics that are observed are due to the irreversible excitation of a hydrogen adatom into a delocalized, two-dimensional band state on the surface with an activation energy of 47 kcal/mol. The desorption reaction occurs between this excited hydrogen adatom and a second, localized hydrogen adatom. The mechanism was verified by adsorption of atomic hydrogen into the band state and the observation of reaction with localized deuterium adatoms at a temperature below that at which desorption from the surface normally occurs. GRA

N89-13534# United Technologies Research Center, East Hartford, Conn.
ACCELERATED COMBUSTION THROUGH STREAMWISE VORTICITY STIRRING Final Report, 1 Jun. 1986 - 30 Jun. 1988
John B. McVey 31 Aug. 1988 70 p
(Contract N00014-86-C-0423)
(AD-A198917; UTRC-88-38) Avail: NTIS HC A04/MF A01 CSCL 20D

Experiments were conducted to observe the effect of streamwise vorticity on the rate of propagation of confined, high-speed, non-premixed turbulent flames. Water-flow visualization experiments were first conducted to establish the scale and intensity of the vortex arrays generated by convoluting the trailing edge of the splitter separating two parallel streams; one stream representing the oxidizer and the other stream representing the fuel. Combustion experiments then conducted; these experiments determined that the splitter plate design which generated the most intense vortex array in cold flow caused the flame spreading rate to be roughly twice that produced by a conventional flat splitter. Flame spreading rates were determined by photographing the direct flame emission radiated by atmospheric pressure flames. GRA

N89-13535# Columbia Univ., New York, N.Y. Electrochemical Lab.
THE USE OF THE FREECE TECHNIQUE FOR THE INVESTIGATION OF ELECTROCHEMICAL BEHAVIOR
Technical Report No. 2, 11 Aug. 1988 - 15 Jul. 1989
Ulrich Stimming Jul. 1988 26 p
(Contract N00014-86-K-0642)
(AD-A198980) Avail: NTIS HC A03/MF A01 CSCL 07B

The background, experimental procedures and some results using the FREECE technique are described. Properties of liquid and frozen HC104*5.5H20 with respect to electrical conductivity and deuteron NMR are discussed. Electrochemical behavior of the metal-(liquid or frozen) electrolyte interface as observed in capacity measurements and charge transfer reactions is described. In the case of hydrogen evolution on copper, silver and gold, temperature dependent transfer coefficients are found. For copper and silver, straight Tafel lines with a slope of 85mV independent of temperature result in a transfer coefficient that is proportional to temperature. Some implications of the results for the understanding of electrochemical processes on a molecular level are discussed. The importance of UHV work on water-ion coadsorption on metal surfaces for the understanding of electrochemical processes on a molecular level is emphasized.
GRA

N89-13536# Chicago Univ., Ill. Dept. of Chemistry.
ELASTIC HELIUM SCATTERING STUDIES OF ORDERED OVERLAYERS OF Ar, Kr AND Xe PHYSISORBED ON Ag(111)
Interim Technical Report No. 14
K. D. Gibson, S. J. Sibener, C. Cerjan, and J. C. Light Jun. 1988 32 p Submitted for publication
(Contract N00014-86-K-0254)
(AD-A199089) Avail: NTIS HC A03/MF A01 CSCL 07B

We describe experiments that measured the angle resolved intensity of helium (Ei=18 and 66 MeV) elastically scattering from the surfaces of rare gas overlayers physisorbed on Ag(111). These studies were done on a layer-by-layer basis for 1, 2, 3, and 25 ordered overlayers of Argonne, Krypton, and Xenon. Two types of experiments are described. The first is diffraction, where the scattered helium intensity was measured as a function of the detector angle, with the incident polar and azimuthal angles held constant. In the second type of experiment, selective adsorption, we measured the specular intensity as a function of incident angle. The purpose of these experiments was to examine the helium-surface potential, to assess the relative contributions that various helium-rare gas pair potentials, nonadditive multibody terms, and helium-substrate interactions make to the systems studied. The experiments are compared with the results of accurate close-coupling calculations, in order to quantitatively perform these assessments. The comparisons between the selective adsorption data and scattering calculations demonstrate the extreme sensitivity that such measurements have to the helium-surface potential.
GRA

N89-13537# New Hampshire Univ., Durham. Dept. of Chemical Engineering.
ELECTRO-CATALYTIC REDUCTION OF NITROGEN OXIDES
Topical Report, 17 May 1987 - 30 Jun. 1988
Arun V. Someshwar 12 Jul. 1988 43 p
(Contract DE-AC22-87PC-79852)
(DE88-013028; DOE/PC-79852/T1) Avail: NTIS HC A03/MF A01

This study is aimed at investigating the use of intense electric fields and discharges resulting from the application of such fields to electrodes of small dimensions (such as points or wires) in conjunction with various material surfaces to bring about the reduction of nitric oxides without the aid of other reducing agents such as NH3, CO, etc. Two important observations have been made with respect to the catalytic reduction of NO. The first concerns the inability of the oxygen released from the NO dissociation from leaving the adsorption surface, thus restricting the surface activity. The second relates to the following postulation. In order to explain the low rates of reduction, inspite of fairly low activation energies for NO dissociation over noble metal and transition metal oxide catalysts, the pre-exponential factor in the reaction rate constant must be small. Thus, the goal in this work is to look into possible ways of providing a high electronic density on the catalyst surface that might cause the predominant formation of NO(-), which would then dissociate more readily. In addition, the surface concentration of O(-) ions can be controlled by suitable applications of electrostatic fields. If the NO(-) dissociation led to O(-) then it was felt that strong negative potentials at the surface would help in desorbing the O(-) ions, thus maintaining the initial surface activity.
DOE

N89-13538# Brookhaven National Lab., Upton, N. Y.
GLANCING ANGLE EXAFS (EXTENDED X-RAY ABSORPTION FINE STRUCTURE) STUDIES OF INTERFACIAL REACTIONS: AN APPLICATION TO CuAl THIN FILMS
H. Chen and S. M. Heald 1988 17 p Presented at the 11th Symposium on the Reactivity of Solids, Princeton, N.J., 19 Jun. 1988
(Contract DE-AC02-76CH-00016)
(DE88-015973; BNL-41525; CONF-880623-1) Avail: NTIS HC A03/MF A01

Interface problems are important to studies of reactivity of solids. Since interfaces are often buried, a non-destructive and sensitive probe capable of examining internal interfaces is desirable. A combination of the glancing angle X-ray reflectivity and Extended X-ray Absorption Fine Structure (EXAFS) has been shown to be such a technique. This paper describes the technique and its application to the determination of Cu-Al interface structures. Cu-Al system has been well studied by other techniques, such as Rutherford Backscattering (RBS) and X-ray Diffraction. Those studies identified CuAl2 as the first compound to form at the interface. Using the glancing angle X-ray probe which has higher depth resolution, the initial interface structure was shown to be different from CuAl2. This paper presents further results which show that as the result of annealing treatments, a thicker interface grows with a structure that resembles CuAl2.
DOE

N89-13539# California Univ., Berkeley. Lawrence Berkeley Lab. Center for Advanced Materials.
SUM-FREQUENCY GENERATION FOR SURFACE VIBRATIONAL SPECTROSCOPY
P. Guyot-Sionnest, R. Superfine, J. H. Hunt, and Y. R. Shen Jul. 1988 5 p Presented at the Laser Materials and Laser Spectroscopy, Shanghai, People's Republic of China, 25 Jul. 1988
(Contract DE-AC03-76SF-00098)
(DE88-016668; LBL-24828; CONF-880708-1) Avail: NTIS HC A02/MF A01

Infrared-visible sum-frequency generation can be used for surface vibrational spectroscopy of molecules adsorbed at various interfaces. The highly surface-specific nature of the technique is demonstrated.
DOE

N89-13540# Oak Ridge National Lab., Tenn. Chemistry Div.
THERMAL DECOMPOSITION OF LANTHANIDE AND ACTINIDE TETRAFLUORIDES
John K. Gibson and Richard G. Haire 1988 7 p Presented at the 9th International Congress on Thermal Analysis: ICTA 9, Jerusalem, Israel, 21 Aug. 1988
(Contract DE-AC05-84OR-21400)
(DE88-008380; CONF-880813-1) Avail: NTIS HC A02/MF A01

The thermal stabilities of several lanthanide/actinide tetrafluorides have been studied using mass spectrometry to monitor the gaseous decomposition products, and powder X-ray diffraction (XRD) to identify solid products. The tetrafluorides, TbF sub 4, CmF sub 4, and AmF sub 4, have been found to thermally decompose to their respective solid trifluorides with accompanying release of fluorine, while cerium tetrafluoride has been found to be significantly more thermally stable and to congruently sublime as CeF sub 4 prior to appreciable decomposition. The results of these studies are discussed in relation to other relevant

experimental studies and the thermodynamics of the decomposition processes. DOE

N89-13541# Sandia National Labs., Albuquerque, N. Mex.
SILICON ELECTROCHEMISTRY RELATED TO THE FORMATION OF POROUS SILICON
Michael J. Kelly, Terry R. Guilinger, and Sylvia S. Tsao 1988 1 p Presented at the IEEE SOS/SOI Technology Workshop, St. Simons Island, Ga., 3 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-011201; SAND-88-1386C; CONF-881080-1) Avail: NTIS HC A02/MF A01

We have examined in detail the electrochemistry of both n- and p-type single crystal (100) silicon in the porous silicon formation regime using a rotating Si disk apparatus with a Ag/AgCl reference electrode. Our findings impact the use and optimization of buried n- or p-type layer anodization for silicon-on-insulator (SOI) wafer synthesis. Results are briefly discussed. DOE

N89-13542# Oak Ridge National Lab., Tenn. Health and Safety Research Div.
BIOLOGICAL EFFECTS OF SPARK-DECOMPOSED SF6
G. D. Griffin, M. G. Nolan, C. E. Easterly, I. Sauers, and P. C. Votaw 1988 24 p Presented at the Electrochemical Society Fall Meeting, Chicago, Ill., 9 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE88-012491; CONF-881061-6) Avail: NTIS HC A03/MF A01

Sulfur hexafluoride (SF6) issued as an insulating gas for electrical applications (gas-insulated substations, switchgear, etc.). The gas is inert chemically and innocuous biologically. Electrical discharges (arcs, sparks, corona) in SF6 can produce chemical decomposition of the gas. Analysis by mass spectroscopy in our laboratory has found that discharge of electrical sparks in SF6 can produce a wide variety of decomposition products depending upon electrode composition, moisture content, presence of oxygen, etc. The compounds SOF2, SOF4, SO2F2, SiF4, SO2, HF, SF4 and S2F10 have been identified and quantified in spark-decomposed SF6. Toxicity information on most of these chemicals is sparse, but available data suggest some may have a strong biological toxicity. Analysis of the ability of these individual chemicals to cause cell lethality in cultured cell assays has allowed a toxicity ranking for these compounds and an understanding of which compounds contribute most to cellular toxicity in the cell culture assays. DOE

N89-13543# Los Alamos National Lab., N. Mex.
VERY HIGH PRESSURE MOSSBAUER SPECTROSCOPY USING DIAMOND ANVIL CELLS
M. P. Pasternak and R. D. Taylor 1988 23 p Presented at the 3rd Seeheim Workshop on Mossbauer Spectroscopy, Seeheim, Fed. Republic of Germany, 23 May 1988
(Contract W-7405-eng-36)
(DE88-016230; LA-UR-88-2559; CONF-8805189-1) Avail: NTIS HC A03

The technique of generating very high pressure by means of Diamond Anvil Cells (DAC) for Mossbauer Effect applications is outlined. A comprehensive description is presented of the principles of DAC, modification for the use in Mossbauer Spectroscopy (MS), the Merrill--Bassett and Bassett cells, of pressure measurements, of gasketing and collimation, and of hydrostatic media. Examples of ^{3}u-151, Sn-119 and I-129 are given showing the feasibility of DAC applications in MS. Other isotopes with potential use for high pressure MS using DAC are suggested. DOE

N89-13544# Sandia National Labs., Albuquerque, N. Mex.
A CRITICAL REVIEW OF HIGH-TEMPERATURE HYDROGEN COMBUSTION IN REACTOR SAFETY APPLICATIONS
Douglas W. Stamps and Marshall Berman 1988 18 p Presented at the International European Nuclear Society/American Nuclear Society Meeting on Thermal Reactor Safety, Avignon, France, 2 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-016368; SAND-88-0680C; CONF-881014-8) Avail: NTIS HC A03/MF A01

The effect of elevated temperature on the various modes of combustion of hydrogen-air-steam mixtures is reviewed. The modes include spontaneous combustion, diffusion flames, deflagrations, and detonations. The purpose of this paper is to review the existing data on high-temperature hydrogen combustion, identify areas where uncertainties exist, and discuss the importance of these uncertainties with respect to reactor safety for three different accident scenarios. DOE

N89-13545# Idaho National Engineering Lab., Idaho Falls.
REPLACEMENT OF CHLORINATED HYDROCARBONS
J. M. Beller, P. A. Pryfogle, D. F. Suciu, and P. M. Wikoff 1988 14 p Presented at Process Technology '88: The Key to Hazardous Waste Minimization, Sacramento, Calif., 15 Aug. 1988
(Contract DE-AC07-76ID-01570)
(DE88-016945; EGG-M-88336; CONF-880879-1) Avail: NTIS HC A03/MF A01

Methods have been identified and tested for systematic evaluations of biodegradable solvents for aircraft parts cleaning, degreasing, and masking-wax removal processes. Screening test have identified solvents that are biodegradable and can efficiently remove masking wax from aircraft parts in a dip tank, and meet the Military Specifications for corrosion. A process data base has been developed to identify all the the processes undertaken at the five Air Force Logistics Commands. To test solvent biodegradability, an ASTM method has been modified consisting of testing a bench scale activated-sludge system and measuring chemical oxygen demand (COD) and adenosine triphosphate (ATP) over a 6-hour period to establish if COD will be reduced to below NPDES limits by the bacteria. Test coupons were coated with masking wax and the cleaning and degreasing efficiency of potential replacement solvents was compared to 1,1,1-trichloroethane and P-D 680 by submerging the coupons in dip tanks for one hour and determining their weight loss. DOE

N89-13546*# National Aeronautics and Space Administration, Washington, D.C.
ANALYSIS OF IGNITION IN A BOMB
M. Fontenille Dec. 1988 14 p Transl. into ENGLISH from Analyse de l'Allumage en Bombe, Sciences de Techniques de l'Armement, France, v. 60, no. 3, 1986 p 289-300 Original language document was announced in IAA as A87-37007 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20402; NAS 1.77:20402; ISSN-0151-0290) Avail: NTIS HC A03/MF A01 CSCL 21B

A series of explosive firings with different powder compositions (B, GX, and UG), different temperatures (+20, -20, and 51 C), and different pyrotechnical compositions (PN, Zr/PbCrO4, Al/KClO4, and Al/CuO) were analyzed. Based on measurements of the pressure development, the powder consumption law is derived, and the temperature behavior is studied. No clear relationship between ignition composition and the temperature behavior of the powder was demonstrated by the results, though more scattered results were found for the standard composition than for Al/CuO and PN. IAA

N89-13547*# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering and Engineering Mechanics.
MODELING OF HYDROGEN-AIR DIFFUSION FLAME
Semiannual Report
K. M. Isaac 28 Dec. 1988 14 p
(Grant NAG1-861)
(NASA-CR-181357; NAS 1.26:181357) Avail: NTIS HC A03/MF A01 CSCL 21B

Work performed during the first six months of the project duration for NASA Grant (NAG-1-861) is reported. An analytical and computational study of opposed jet diffusion flame for the purpose of understanding the effects of contaminants in the reactants and thermal diffusion of light species on extinction and

reignition of diffusion flames is in progress. The methodologies attempted so far are described. Author

N89-13673*# Massachusetts Inst. of Tech., Cambridge.
PHASE SEPARATION KINETICS IN IMMISCIBLE LIQUIDS
D. R. Sadoway *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 9-11
(For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N89-13548 Stanford Univ., Calif.
A STUDY OF FATIGUE MICROCRACK GROWTH IN ALUMINUM ALLOY 7075-T651 Ph.D. Thesis
Jung Sup Chung 1988 346 p
Avail: Univ. Microfilms Order No. DA8808354

It was observed in recent studies that the fatigue crack propagation rate for very small cracks is often different from that of large cracks at the same range of applied stress intensity factor, delta K, the parameter used most frequently in predicting the growth rate of large cracks. Small crack growth was investigated experimentally in a commonly used structural aluminum alloy, 7075-T651, for different strain amplitudes. Two types of specimens were used: rotating bending and a wide plate in cantilevered bending. The rotating bending specimen was close to uniaxial stress while the plate had biaxial tension near its center, where data on crack growth were taken. Tests of plate specimens were also conducted for several different R-ratios at a lower strain amplitude. Cracks started slightly sooner in plate specimens than in rotating bending specimens for a given strain amplitude. Cracks initiated sooner in plate specimens at R = 0 than R = -1 for tests with a strain amplitude of 0.35 percent. When microcrack growth rate in plate specimens at R = -1, divided by crack length, is plotted on log-log coordinates vs range of maximum shear strain, or range of octahedral shear strain, the data tend to follow one line. In other words, crack growth rate was found to be proportional to the product, of one of these strain range parameters with an exponent and crack length. For maximum shear strain range, the data from plate specimens and those from rotating bending specimens correlated well. Dissert. Abstr.

N89-13549# Naval Ship Research and Development Center, Bethesda, Md. Ship Materials Engineering Dept.
ELECTROCHEMICAL IMPEDANCE OF ORGANIC COATED STEEL: CORRELATION OF IMPEDANCE PARAMETERS WITH LONG TERM COATING DETERIORATION
John R. Scully Apr. 1988 105 p
(AD-A196878; DTRC/SME-86/108) Avail: NTIS HC A06/MF A01 CSCL 11F

Electrochemical impedance results are presented for 550 day exposures of organic coated carbon steel samples. Coatings consisted of translucent pigmented and unpigmented epoxy and conventional opaque epoxy polyamide systems. Coating thicknesses ranged from 20 to 185 microns. Specimens were exposed under freely corroding conditions and at two cathodic polarization levels (-805 mV and -1250 mV versus SCE) in ASTM artificial ocean water. The objective was to identify Impedance parameters which measure subcritical coated-metal system property changes at early exposure times that are indicators of significant long term coating deterioration. Impedance data developed at early times, including coating resistance, coating capacitance, the increase in frequency associated with the coating's resistive-capacitive (RC) 45 degree phase angle, and low frequency impedance data, are compared to the coating system's performance evaluated after 550 days exposure. GRA

N89-13550# Brookhaven National Lab., Upton, N. Y.
SOFT MODE BEHAVIOR IN Ni-Al ALLOYS
S. M. Shapiro, B. X. Yang, G. Shirane, J. Z. Larese, L. E. Tanner, and S. C. Moss (Houston Univ., Tex.) Jun. 1988 8 p Presented at the 4th International Conference on Neutron Scattering (ICNS '88), Grenoble, France, 12 Jul. 1988
(Contract DE-AC02-76CH-00016)
(DE88-015195; BNL-41469; CONF-880715-5) Avail: NTIS HC A02/MF A01

Inelastic neutron scattering experiments performed on carefully prepared single crystals of Ni(sub x)Al(sub 1-x) (x = 50, 58, 62.5 at. percent) reveal an anomaly in the (zeta zeta 0)-TA mode whose position in zeta depends linearly on x. The temperature dependent studies of the 62.5 percent alloy show marked softening of the phonon energy at zeta=i/6. At the same temperatures, an elastic central peak develops. At T sub M = 80K a new structure develops which exhibits a modulation at nearly, but not exactly, zeta = 1/7. DOE

N89-13551# Army Armament Research, Development and Engineering Center, Watervliet, N.Y. Weapons Lab.
PREMARTENSITE TRANSFORMATION IN Ni(50.5)Ti(49.5) Final Technical Report
L. V. Meisel and P. J. Cote Apr. 1988 26 p
(AD-A197458; ARCCB-TR-88019) Avail: NTIS HC A03/MF A01 CSCL 11F

Small deviations from stoichiometry in the thermoelastic NiTi martensitic alloy yield sufficiently large separation of the martensite and premartensite transformations to allow a thermal analysis study of the premartensite transformation without the complication of competing phenomena. The nature of the premartensite transformation in Ni50.5Ti49.5 and its relation to similar phenomena in stoichiometric and iron-doped NiTi is the subject of the present report. Data indicate that the premartensite transformation width in Ni50.5Ti49.5 is due to a distribution of regions of the sample that transform from the cubic to the rhombohedrally distorted CsCl phase over a range of temperatures, and these regions transform back to cubic CsCl structure in reverse order upon reheating. In contrast to the results in iron-doped NiTi, no evidence of a two-step transformation could be found in a series of studies of the metastability and transformation kinetics of mixtures of phases produced by partially transforming from the pure CsCl phase and from the pure rhombohedrally distorted CsCl phase. GRA

N89-13552# Kansas State Univ., Manhattan. Dept. of Physics.
INVESTIGATION OF AS-CAST IRON-LIGHT RARE-EARTH-BORON ALLOYS FOR PERMANENT MAGNETS Final Report, 1 Feb. 1984 - 31 Jan. 1987
G. C. Hadjipanayis 1 Jul. 1988 16 p
(Contracts MIPR-126-84; MIPS-112-85)
(AD-A197491; ARO-21380.1-MS) Avail: NTIS HC A03/MF A01 CSCL 11F

The magnetic and structural properties of Fe-R-B magnets were studied in the melt-spun and sintered state. The formation of Fe14R2B phase including its magnetic properties (Curie temperature, magnetic moment and coercivity) and the effects of partial substitutions of iron, rare earth and metalloid were studied in melt spun samples. The magnetic properties of as-cast Fe-R-B powders were examined as a function of particle size. The fine powders were sintered into dense magnets and the properties of the magnets were examined over a range of temperatures. The magnetic properties of all samples (melt-spun, powders and sintered magnets) were correlated with the microstructure and magnetic domain structure in an attempt to elucidate the origin of magnetic hardening in these materials. The results of these studies indicate that the high coercivities are due to domain wall pinning at grain boundaries in ribbons and sintered magnets and at the surface of the particles in powders. Author

N89-13553# State Univ. of New York, Buffalo. Dept. of Chemistry.
CORROSION MEASUREMENTS USING MICROELECTRODES Technical Report No. 19
Kazimierz Wikiel and Janet Osteryoung 8 Jul. 1988 33 p

(Contract N00014-84-K-0052)
(AD-A197744) Avail: NTIS HC A03/MF A01 CSCL 11F

It is shown that microelectrodes can be substituted for large area electrodes in typical corrosion measurements. Results obtained for copper and iron in concentrated solutions are consistent with earlier literature reports. Application of microelectrodes markedly reduces the effects of IR-ohmic drops. It allows one to apply electrochemical methods in corrosion investigations under conditions closer to those of natural corrosion environments. The corrosion rate of circular copper microelectrodes in 0.1 mol/cu dm HCl solution depends on radius and increases with decreasing radius. GRA

N89-13554*# Alabama A & M Univ., Normal. Dept. of Physics.
A STUDY OF MICROSTRUCTURAL CHARACTERISTICS OF Ni-BASED SUPERALLOYS AT HIGH TEMPERATURES Semiannual Technical Report
R. B. Lal and M. D. Aggarwal 22 Nov. 1988 59 p
(Grant NAG8-076)
(NASA-CR-183377; NAS 1.26:183377; AAMU-NAG-002) Avail: NTIS HC A04/MF A01 CSCL 11F

The microstructural characteristics of the Ni-based superalloy MAR-M246(Hf) which is used in manufacturing the components of the Space Shuttle's main engine have been studied. These superalloys need optimal heat treatment to get the best results. To find the optimum heat treatment the technique of differential thermal analysis and the optical photomicrographs are being planned to be utilized. In the first phase, the existing experimental equipment like cutting, grinding/polishing machines and metallurgical microscope have been set up to cut/polish and take the photomicrographs. In the beginning of this year an order was placed for the Leitz Mettalux-3 microscope with a hot stage for in-situ observation of the superalloy samples. The hot stage was tested for the first time, alloying the thermocouple with the Tantulum heating element and has not been installed finally by the supplier. A Perkin Elmer Differential Thermal Analyzer (DTA 1700) was procured in the first year of the project. Samples of MAR-M246(Hf), MAR-M247, Waspaloy, Udimet-41, CMSX-2 and CMSX-3 (polycrystalline and single crystals) have been studied using differential thermal analyzer. Author

N89-13555# Massachusetts Inst. of Tech., Cambridge.
ENGINEERING INTERFACES IN METAL MATRIX COMPOSITES, VOLUME 3 Final Technical Report
James A. Cornie 10 Jun. 1988 369 p
(Contract N00014-84-K-0495)
(AD-A198746) Avail: NTIS HC A16/MF A01 CSCL 11F

The critical energy release rate for separation of thin coatings from their substrate can be determined accurately in many instances when the coatings are elastic, and are under a state of residual stress. When the thickness of such coatings reaches a critical value, so that the elastic strain energy per unit surface area in them equals the specific work of fracture of the interface, the coating will delaminate from the substrate in quasi-static equilibrium. Through analysis of such delaminations of SiC coatings from single crystal Si substrates and Pitch-55 carbon fibers, the intrinsic toughness of Si-SiC and C-SiC interfaces have been determined. GRA

N89-13556# Georgia Univ., Athens.
REACTIONS OF TRANSITION METAL CLUSTERS WITH SIMPLE HYDROCARBONS Final Report, 1 Mar. 1985 - 31 May 1988
Michael A. Duncan 20 Jul. 1988 9 p
(Contract DAAG29-85-K-0040)
(AD-A198798; ARO-21783.11-CH) Avail: NTIS HC A02/MF A01 CSCL 07B

Metal clusters are small aggregates of metal atoms which can be produced in molecular beam environments using laser vaporization pulsed nozzle techniques developed over the last several years. Such clusters are interesting because they provide model systems in which to study condensation phenomena, metal-metal bonding, metal-adsorbate bonding, and novel isomerism/rearrangement phenomena. Additionally, measurements of properties as a function of size probe the gradual trend from atomic and molecular behavior to bulk solid behavior. In the current project, various aspects of cluster electronic structure, metal bonding, and chemical reactivity have been considered. GRA

N89-13557# Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
THE ROLE OF SURFACE BONDING ON LIQUID CRYSTAL ORIENTATIONAL ORDERING AT METAL SURFACES
P. N. Sanda, D. B. Dove, H. L. Ong, S. A. Jansen (Temple Univ., Philadelphia, Pa.), and R. Hoffmann Jul. 1988 23 p
(Contract N00014-82-K-0576)
(AD-A198808; TR-40) Avail: NTIS HC A03/MF A01 CSCL 07B

The alignment of a nematic liquid crystal, 4'-n-pentyl-4-cyanobiphenyl (5CB), on several smooth metal (chromium, copper, silver, and gold) surfaces was observed experimentally. Perpendicular (homeotropic) induced alignment was observed for copper and copper boundary layers, whereas parallel alignment was observed for chromium and copper. These differences are discussed in relation to the differences in chemical bonding interactions at the surfaces as described by theoretical calculations performed for the cases of copper, chromium, and gold. Several differences in orbital interactions, as well as a sensitivity to bonding configurations, are illustrated with the aid of extended Huckel calculations on hypothetical organometallic complexes and extended Huckel/tight binding calculations of the interface for parallel versus perpendicular absorbate orientations. GRA

N89-13558# California Univ., Berkeley. Lawrence Berkeley Lab. Center for Advanced Materials.
MECHANICAL PROPERTIES OF HIGH-STRENGTH ALUMINUM ALLOYS AT CRYOGENIC TEMPERATURES
J. W. Morris, Jr. and J. Glazer Jun. 1988 20 p Presented at the International Conference on Cryogenic Materials Applications and Properties, Shenyang, People's Republic of China, 7 Jun. 1988
(Contract DE-AC03-76SF-00098)
(DE88-016122; LBL-25254; CONF-880653-4) Avail: NTIS HC A03/MF A01

This paper reviews the cryogenic mechanical behavior of high-strength aluminum alloys and describes some of the potential applications of these alloys at cryogenic temperatures. The aluminum alloys are unusual in that their mechanical properties often improve with decreasing temperature. The mechanical property data is summarized and briefly compared to that for other fcc materials, such as austenitic steels and nickel-based alloys, many of which also have better mechanical properties at low temperature. The cryogenic properties of aluminum alloys are discussed and interpreted in light of the current mechanistic theories of the influence of temperature on mechanical behavior. The discussion emphasizes the behavior of advanced aluminum-lithium alloys, which have exceptional mechanical properties at cryogenic temperature. DOE

N89-13559# Sandia National Labs., Albuquerque, N. Mex.
SOLUTE INTERACTIONS IN METALS
S. M. Myers 1988 20 p Presented at the Metallurgical Society Fall Meeting, Cincinnati, Ohio, 10 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004958; SAND-87-0818C; CONF-881030-1) Avail: NTIS HC A03/MF A01

Studies of the trapping mechanisms and precipitation reactions which influence solute behavior in metals have recently been enhanced by three developments. First, a new experimental approach based on ion implantation and ion-beam analysis provides an effective means for the quantitative characterization of solute interactions. Second, the recently established effective-medium theory yields quantitative or semiquantitative information on binding enthalpies and atomic configurations. Finally, overall solute behavior can be accurately modeled in terms of individual interaction mechanisms through numerical solution of advanced

transport formalisms. These methods have been extensively applied to the trapping of hydrogen by irradiation defects. They have also been used successfully to treat a variety of other solutes, both light interstitials and substitutional species, and the investigated binding mechanisms have ranged beyond irradiation-associated effects to include trapping at precipitates and chemical reactions leading to phase changes. DOE

N89-13560# Los Alamos National Lab., N. Mex.
SHOCK COMPACTION OF RAPIDLY SOLIDIFIED NICKEL BASED MoAlW ALLOY POWDERS WITH PRESSURE UP TO 1.2 mbar
Karl Paul Staudhammer 1988 9 p Presented at HERAPS '88: International Seminar on High Energy Working of Rapidly Solidified Materials, Novosibirsk, USSR, 10 Oct. 1988
(Contract W-7405-eng-36)
(DE88-009144; LA-UR-88-1184; CONF-881060-1) Avail: NTIS HC A02/MF A01

Described is a high strength nickel alloy containing 10 wt pct Mo, 6.8 wt pct Al, and 6 wt pct W. It cannot be easily prepared by conventional casting methods without gross segregation occurring in the form of massive dendrites. Gas atomization to form fine powders reduces the dendrite size and therefore, the segregation. The spacing of the secondary dendrite arm has been used to estimate the cooling rate of this powder. The experimental investigation of shock compaction is based in part on mach stem lens formation work. One of the fortuitous aspects of the cylindrical explosion design is its suitability as a screening tool with its very high success rate of recovery. Use of the radial implosion design has allowed for the determination of optimum pressures required for consolidation of RSR Ni--10Mo--6.8Al--6W alloy powders as a function of initial packing density. These sets of experiments are in line with previous work on other shock consolidated powders showed that an increase of initial density decreased the melt zone, and only required a slight increase in the pressure to consolidate. DOE

N89-13561# Florida Univ., Gainesville. Dept. of Physics.
TIME RESOLVED X-RAY SCATTERING STUDY OF THE ORDERING KINETICS IN THIN FILMS OF Cu3Au
S. E. Nagler, R. F. Shannon, Jr., and C. R. Harkless 1987 3 p Presented at the Dynamics of Ordering Processes in Condensed Matter, Kyoto, Japan, 27 Aug. 1987
(Contract DE-FG05-86ER-45280)
(DE88-014544; DOE/ER-45280/2; CONF-8708122-2) Avail: NTIS HC A02/MF A01

We report the preliminary results of time resolved X-ray scattering measurements of the kinetics associated with the order-disorder transition in thin films of Cu3Au. The results to date find that late time ordering in Cu3Au is probably isotropic, and growth of domain size in films down to 950 A is consistent with a Cahn-Allen growth law as observed in bulk crystals. Early time ordering may be strongly affected by film thickness. DOE

N89-13562# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
EXPERIMENTAL STUDY OF GRAIN BOUNDARY MELTING IN ALUMINUM
T. E. Hsieh and R. W. Balluffi Sep. 1988 28 p
(Contract DE-FG02-87ER-45310)
(DE88-017082; DOE/ER-45310/8) Avail: NTIS HC A03/MF A01

Experiments aimed at determining whether grain boundaries melt completely to structures which closely resemble their undercooled bulk liquid at temperatures appreciably below the bulk melting temperature, T sub m, were performed. A variety of grain boundaries in Al, containing localized grain boundary dislocation (GBD) arrays, was observed directly by hot stage electron microscopy during heating to close to T sub m. No delocalization of the GBD cores was observed up to T = 0.96 T sub m indicating an absence of melting. Polycrystalline Al specimens were partially melted in the hot stage and the grain boundaries in the direct vicinity of the liquid/solid interface were searched for possible melting. No signs of melting were detected for temperatures up to 0.999 T sub m. Results indicate that complete grain boundary melting occurs only essentially at T sub m. The results are consistent with atomistic simulations in the literature which indicate that grain boundaries become preferentially disordered on heating. DOE

N89-13563# General Electric Co., Schenectady, N.Y. Corporate Research and Development Center.
DETECTION AND CHARACTERIZATION OF NOVEL METAL-BINDING PROTEINS Annual Report No. 3, 1986 - 1987
D. S. Holmes and T. K. Leib May 1988 20 p
(Contract DE-FG02-84ER-13278)
(DE88-017097; DOE/ER-13278/T1) Avail: NTIS HC A03/MF A01

The research proposed and carried out under this grant concerned the detection and characterization of novel metal-binding proteins. In particular, the research goals as outlined in the original proposal were to detect novel metalloproteins from unusual bacteria such as Thiobacillus and Sulfolobus, to characterize one or more such novel metal-binding proteins, and as a long range goal beyond the scope of the proposal, to explore the conditions necessary for an industrial or scientific application of metal-binding proteins and to determine its relative advantages and limitations for the proposed application. Naturally occurring, metal-binding proteins are generally not a major component of living organisms and are thus difficult to identify and isolate. An important part of this research involved the development of techniques that would enable us to examine the proteins of bacteria for the presence of novel metal-binding proteins. Since many metal-binding proteins are rich in cysteine, we placed emphasis on techniques that would detect cysteine in proteins. The techniques that we examined included polyacrylamide gel electrophoresis of (S-35)cysteine-labeled cellular proteins, fast protein liquid chromatography (FPLC), and high-pressure liquid chromatography (HPLC) with on-line detection of copper or sulfhydryl groups. We demonstrated that these techniques work in model systems (yeast metallothionein and synthetic metal-binding polypeptides), and used them to examine the cellular proteins of Acidiphilium organovorum. Unfortunately, we were unable to identify any novel metal-binding proteins in this unusual, metal-resistant bacterium. DOE

N89-13564# Sandia National Labs., Albuquerque, N. Mex. Photovoltaic Technology Div.
EVALUATION AND LIFE TESTING OF COPPER-COATED ALUMINA
Leonard C. Beavis Aug. 1988 55 p
(Contract DE-AC04-76DP-00789)
(DE89-000629; SAND-88-0229) Avail: NTIS HC A04/MF A01

Metallized ceramics are commonly used substrates for solar cells in point-focus photovoltaic concentrator modules. A high percentage of failures in the copper-ceramic interface is occasionally found after thermal cycling. To better understand the cause of the failures, we prepared and thermally cycled several samples. Failed samples were found to contain purer alumina, had been fired at lower temperatures, and exhibited interfacial chlorine-probably from the flux used to apply the solder layer. The use of appropriate materials and processes should eliminate interfacial failure resulting from thermal cycling. DOE

N89-13565# Aeronautical Research Labs., Melbourne (Australia).
ON THE MEAN STRESS DEPENDENCE OF THE THERMOELASTIC PARAMETER FOR THREE HIGH STRENGTH ALLOYS
S. A. Dunn, A. K. Wong, and J. G. Sparrow Jul. 1988 22 p
(AD-A198359; ARL-STRUC-R-433; DODA-AR-005-517) Avail: NTIS HC A03/MF A01 CSCL 11F

Experimental verification for the theoretical basis of the mean stress dependence of the thermoelastic parameter is presented here for 4340 steel and collated with previous results for 2024 aluminum and 6 Al-4V titanium alloys. Various experimental techniques are described and their relationship with the theory is

discussed in detail. Finally, the means by which the thermoelastic effect may be used to determine residual stresses in practice is discussed. GRA

N89-13566*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF 0.1 ATOMIC PERCENT ZIRCONIUM ON THE CYCLIC OXIDATION BEHAVIOR OF BETA-NiAl FOR 300 HOURS AT 1200 C
C. A. Barrett [1988] 19 p Presented at the Workshop on the Oxidation of High-Temperature Intermetallics, Cleveland, Ohio, 22-23 Sep. 1988; sponsored by ASM International, NASA Lewis Research Center, Case Western Reserve Univ, AIME and TMS-AIME
(NASA-TM-101408; E-4366; NAS 1.15:101408) Avail: NTIS HC A03/MF A01 CSCL 11F

The long time effect of 0.1 at percent Zr (0.2 wt percent Zr) on the cyclic oxidation behavior of hipped beta-NiAl was studied. Oxidation testing was performed in static air at 1200 C for up to 3000 one-hour exposure cycles. Specific weight change versus time data was modeled with the COSP computer program to analyze cyclic oxidation behavior. The Zr-free stoichiometric alloy oxidized and spalled randomly to bare metal between cycles at a rate high enough to deplete Al to a low enough level that oxidation breakaway took place as nonprotective NiO replaced the alpha-Al2O3/NiAl2O4 scale as the controlling oxide. The Zr minimized this severe type of spalling maintaining the protective alpha-Al2O3 scale even out to 3000 hours for the stoichiometric alloy with no significant Al depletion. A third beta-NiAl alloy containing 0.1 at percent Zr but with 10 percent less Al than the stoichiometric alloy was also tested and showed some depletion of Al, but the protective Al2O3/NiAl2O4 was still maintained to close to 2700 hours. Author

N89-13567 Akron Univ., Ohio.
A VISCOPLASTIC CONSTITUTIVE THEORY FOR TRANSVERSELY ISOTROPIC METAL ALLOYS Ph.D. Thesis
Stephen F. Duffy Jan. 1987 136 p
Avail: Univ. Microfilms Order No. DA8704739

A multiaxial constitutive theory that captures the complex thermomechanical behavior of metal alloys used in high temperature applications is presented. The complete theory is derived from the flow potential function omega. Tensorial invariant theory served as the basic tool in the development of omega. Integrity bases were derived from the scalar functions, F and G, upon which the dependence of Q was taken. Projections of F=constant representing constant inelastic-states illustrated the potential-normality structure of a transverse isotropic material. An experimental procedure for determining the material parameters characterizing both viscoplasticity and anisotropic strength. Theoretical predictions of homogeneously stress and strained elements were presented and discussed. B.G.

N89-13568*# Martin Marietta Corp., Denver, Colo. Astronautics Group.
NDE DETECTABILITY OF FATIGUE-TYPE CRACKS IN HIGH-STRENGTH ALLOYS: NDI RELIABILITY ASSESSMENTS Final Report
Brent K. Christner, Donald L. Long, and Ward D. Rummel Sep. 1988 330 p
(Contract NAS8-35503)
(NASA-CR-183539; NAS 1.26:183539; MCR-88-1044) Avail: NTIS HC A15/MF A01 CSCL 11F

This program was conducted to generate quantitative flaw detection capability data for the nondestructive evaluation (NDE) techniques typically practiced by aerospace contractors. Inconel 718 and Haynes 188 alloy test specimens containing fatigue flaws with a wide distribution of sizes were used to assess the flaw detection capabilities at a number of contractor and government facilities. During this program 85 inspection sequences were completed presenting a total of 20,994 fatigue cracks to 53 different inspectors. The inspection sequences completed included 78 liquid penetrant, 4 eddy current, and 3 ultrasonic evaluations. The results of the assessment inspections are presented and discussed. In generating the flaw detection capability data base, procedures for data collection, data analysis, and specimen care and maintenance were developed, demonstrated, and validated. The data collection procedures and methods that evolved during this program for the measurement of flaw detection capabilities and the effects of inspection variables on performance are discussed. The Inconel 718 and Haynes 188 test specimens that were used in conducting this program and the NDE assessment procedures that were demonstrated, provide NASA with the capability to accurately assess the flaw detection capabilities of specific inspection procedures being applied or proposed for use on current and future fracture control hardware program. Author

N89-14161*# California State Polytechnic Univ., Pomona. Dept. of Chemical and Materials Engineering.
EVALUATION OF CANDIDATE ALLOYS FOR THE CONSTRUCTION OF METAL FLEX HOSES IN THE STS LAUNCH ENVIRONMENT
Cordelia Ontiveros *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 179-206 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 11F

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N89-13569*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5055B LOT 1
[1986] 220 p
(Contract NAS8-36298)
(NASA-CR-179414; NAS 1.26:179414; D-09256) Avail: NTIS HC A10/MF A01 CSCL 11B

Test results for FM 5055B Lot No. 1 for filler testing, resin testing, fabric testing, and prepreg testing are presented in tabular and graphic format. B.G.

N89-13570 Massachusetts Univ., Amherst.
THE THERMODYNAMICS OF DEFORMATION FOR THERMOPLASTIC POLYMERS Ph.D. Thesis
Gary William Adams 1987 175 p
Avail: Univ. Microfilms Order No. DA8805888

The post-yielding behavior of some common thermoplastics was examined in unaxial tension to determine if these materials were ideally plastic from a thermodynamic viewpoint. Various polyethylenes, poly(methyl methacrylate), and polycarbonate, polyarylate, and polysulfone based on bisphenol A were studied. Thermodynamic measurements were made during deformation of an isothermal deformation calorimeter capable of measuring the work and heat of deformation. Thermodynamically ideal plasticity was not observed for any of the polymers examined. The polyethylenes stored approximately 30 percent of the input work as a latent internal energy change while this value was 40 to 50 percent for the amorphous glasses. Addition experiments were performed to determine the mechanism of deformation energy staorage and to ascertain the implications of this stored energy in engineering applications. Relaxations at temperatures much less thatn glass transition temperature (T sub g) were observed for the drawn amorphous glasses using dynamic mechanical and differential scanning calorimetry measurements. These experiment observations were explained in terms of a proposed deformation model which involves chain formation with breakage and reformation of intermolecular secondary bonds. Author

N89-13571*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5055B LOT 3
[1986] 188 p
(Contract NAS8-36298)
(NASA-CR-179408; NAS 1.26:179408; C-02133) Avail: NTIS HC A09/MF A01 CSCL 11B

Test results for FM 5055B Lot No. 3 for filler testing, resin testing, fabric testing, and prepreg testing are presented in tabular and graphic format. B.G.

N89-13572*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5064J (HITCO) LOTS 1 (H) - 4 (H)
[1986] 261 p
(Contract NAS8-36298)
(NASA-CR-179410; NAS 1.26:179410) Avail: NTIS HC A12/MF A01 CSCL 11B

Test results for FM 5064 J (HITCO) Lots No. 1 (H) - 4 (H) for filler testing, resin testing, fabric testing, and prepreg testing are presented in tabular and graphic format. B.G.

N89-13573*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5839 LOT 4
[1986] 125 p
(Contract NAS8-36298)
(NASA-CR-179412; NAS 1.26:179412; D-09317) Avail: NTIS HC A06/MF A01 CSCL 11B

Test results for FM 5839 Lot No. 4 for filler testing, resin testing, fabric testing, prepreg testing are presented in tabular and graphic format. B.G.

N89-13574# Michigan Molecular Inst., Midland.
THE 1987 MMI INTERNATIONAL SYMPOSIUM ON POLYMER MELT DYNAMICS Final Report
1987 43 p Symposium held in Midland, Mich., 16-19 Aug. 1987
(Grant N00014-87-G-0196)
(AD-A192282) Avail: NTIS HC A03/MF A01 CSCL 11I

The papers presented at the symposium are given. Some representative topics are: A Generalized Rouse Theory for Entangled Polymeric Liquids; Alternative View of Chain Entanglement; Long Time Dynamic Properties of Dense Polymer Model Systems; Polymer Dynamics in Random Fields; Dynamics of Entangled Polymers; What is Reptation; Critical Tests of the Dynamics of Entangled Polymers; Many Chain Interactions in the Reptation Model; and Diffusion of Branched and Linear Polymers in Concentrated Solutions. For individual titles, see N89-13575 through N89-13603.

N89-13575# Konstanz Univ. (West Germany).
A GENERALIZED ROUSE THEORY FOR ENTANGLED POLYMERIC LIQUIDS Abstract Only
Walter Hess *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 1 Prepared in cooperation with Max-Planck-Inst. fuer Polymerforschung, Mainz (Fed. Republic of Germany) (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Starting from the Liouville equation for a system of interacting chains, relaxation equations for the segment coordinates of one test chain are derived. These equations have the form of generalized Rouse equations with a time-dependent memory kernel instead of a constant relaxation time. The memory kernel can be related to a dynamic friction function, which is given by the correlation function of forces between test chains and the other chains of the system. A systematic calculation of the friction function is proposed, which relies on the translational invariance of the interaction potential of two chains against curvilinear displacements. This symmetric principle is only violated by the end effects of the chains. To zero order in the end effects curvilinear motion of a one-dimensional Rouse chain, lateral motion is strongly hindered by interaction and freezes in at a critical chain length or concentration. This might be called the reptation transistion. The friction function is now calculated to first order in the end effects (using the zero-order curvilinear and lateral propagators). Beyond the reptation transition the spectrum splits into high-frequency Rouse modes and into a low-frequency part, which is dominated by interaction effects. Author

N89-13576# Colorado State Univ., Fort Collins.
ALTERNATIVE VIEWS OF CHAIN ENTANGLEMENTS Abstract Only
Marshall Fixman *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 2 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Three aspects of the motion of rod and chain polymers in the semidilute and concentrated regimes is discusses: (1) The failure of dynamical simulations to show visible evidence for reptative motion in tubes; (2) The propensity of experiments and simulations to show that the longest relaxation time for angular rotation or internal stresses is greater than the time for a molecule to diffuse across one radius of gyration; and (3) The quantitative description of models devised on the assumption that these observations are not misleading and would persist to arbitrarily large chain length. Author

N89-13577# Washington Univ., Seattle.
LONG TIME DYNAMIC PROPERTIES OF DENSE POLYMER MODEL SYSTEMS Abstract Only
Jeffrey Skolnick *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 3 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Dynamic Monte Carlo simulations of long chains confined to a cubic lattice at a polymer volume fraction of phi = 0.5 were performed to investigate the dynamics of polymer melts. In the range of chain lengths n, from n = 64 to n = 800, this model system exhibits a crossover from a weaker dependence of the diffusion coefficient D on chain length to a much stronger one, consistent with D = n sup -2. Since the n sup -2 scaling relation signals the onset of highly constrained dynamics, an analysis of the character of the chain contour motion was performed. In agreement with previous simulations on a diamond lattice, no evidence for the well-defined tube required by the reptation model of polymer melt dynamics was found. The lateral motions of the chain contour are still large even in the case when n = 800, and the motion of the chain is essentially isotropic in the local coordinates. Hence, the crossover to the D = n sup -2 regime with increasing chain length of this monodisperse, model melt is not accompanied by the onset of reptation dynamics. The dynamics were explored of a probe chain consisting of N sub P = 100 segments in a matrix of chains of length of n sub M = 50 up to n sub M = 800 at a total volume fraction of polymer phi = 0.5. Author

N89-13578# Massachusetts Univ., Amherst.
POLYMER DYNAMICS IN RANDOM FIELDS Abstract Only
M. Muthukumar *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 4 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Dynamic and static properties of a polymer chain with and without self excluded volume, which performs Brownian motion between randomly distributed impenetratable fixed obstacles, were investigated by Monte Carlo simulations and analyzed by scaling and theoretical considerations. The mean square radius of gyration, the center of mass diffusion coefficient and the longest relaxation time are functions of x = (1-p) square root of N for all chain lengths N and porosities above the percolation threshold. Simulations were performed for x = to or less than 10. Author

N89-13579# Eastman Kodak Co., Rochester, N. Y.
DYNAMICS OF ENTANGLED POLYMERS Abstract Only
Michael Rubinstein *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 5 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The idea of a confining tube is reexamined and a new definition of an entanglement net is suggested. The dynamics of a single chain in an array of fixed obstacles is also examined. The repton model incorporating reptation and fluctuations in tube length is proposed and solved. The many chain effects, called constraint release, are self-consistently included in the theory and the predictions are compared with oscillatory shear data of binary blends. The dynamics of non-linear entangled polymers, such as stars, rings, etc. are discussed. Author

N89-13580# Wisconsin Univ., Madison.
WHAT IS REPTATION Abstract Only
Hyuk Yu *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 6 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The experimental studies of polymer translational diffusion relative to the reptation model is emphasized. Despite the much heralded agreement with the model prediction for the molecular weight dependence of polymer self diffusion in bulk, detailed experimental studies of various polymers in different media have started to highlight lack of stringency of the commonly accepted reptation criterion. The current status is reviewed of chain diffusion studies whereby conformity and discordance with the above criterion is examined critically. Discussion centers around a proposition that the reptation mechanism is yet to be established universally by experiment as the dominant mode for chain translation diffusion. Author

N89-13581# Weizmann Inst. of Science, Rehovoth (Israel).
DYNAMICS IN ENTANGLED POLYMER BLENDS Abstract Only
Jacob Klein *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 7 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Infra-red microdensitometry, X-ray microanalysis with electron microscopy, and Rutherford backscattering methods are being used to study mutual diffusion in a variety of compatible and partly compatible binary polymer blends. In the compatible blend poly(vinyl chloride) (PVC) / poly(caprolactone) (PCL) the mutual diffusion coefficient has a strong maximum near the 50/50 blend composition; this leads to highly non-fickian concentration profiles on interpenetration between the two pure bulk polymers - which are quantitatively consistent with the independently determined form. For a blend of long and short (but highly entangled) chains of a homopolymer, both of which are reptating, results show that the mutual interpenetration is controlled by the mobility of the shorter chains. The diffusion broadening with time of an originally sharp interface between two compatible polymers at temperatures on both sides of the critical temperature are measured: the results show clearly the fall in the mutual diffusion rate at the higher temperatures, where the system is in the two-phase region. Author

N89-13582# Illinois Univ., Urbana.
CRITICAL TESTS OF THE DYNAMICS OF ENTANGLED POLYMERS Abstract Only
Richard P. Wool *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 8 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Tests of reptation models for the molecular dynamics of polymer melts were conducted by FTIR analyses of selectively deuterated polystyrene (PS) melts, computer simulation and other techniques. Some important results are given. Author

N89-13583# California Univ., Santa Cruz.
MANY-CHAIN INTERACTIONS IN THE REPTATION MODEL Abstract Only
Joshua M. Deutsch *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 9 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Theoretical and numerical work is presented extending the reptation model to include many chain interactions. The relaxation time for long chains is argued to scale. A lattice simulation using reptation dynamics also confirms a prediction. The dynamics of rings is also discussed. Author

N89-13584# Naval Research Lab., Washington, D.C.
A REPTATION MODEL WITH RELAXATION EXPONENT OF 10/3 Abstract Only
Michael F. Shlesinger *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 10 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The reptation model of DeGennes was introduced to determine diffusion and flow properties of long entangled polymers in a melt. A single chain calculation led to the reptation time varying with the chain mass. Scher and Shlesinger proposed a multichain framework which predicted reptation time as M sup x with 3 less than x = to or less than 3.5, and demonstrated that this is compatible with the theoretical and experimental determination of the M sup -2 behavior of a chain's diffusion constant. The present work finds x = 10/3 which finally brings the reptation concept into agreement with experiments. Author

N89-13585# General Electric Co., Schenectady, N.Y.
ENTANGLEMENTS AND CHAIN MOTION IN THE GLASSY STATE Abstract Only
John T. Bendler *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 11 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

A series of mechanical and optical studies were carried out on carefully-prepared (isotropic) samples of bis-phenol A polycarbonate in the glass state to determine the influence of strain, temperature and thermal history on the solid state behavior. Stress relaxation, creep, birefringence/strain recovery, and stress-strain response are rationalized using a simple network model of the glass. Both anelastic and plastic strain accompanies deformation. The former is interpreted in terms of conformational equilibration between entanglement points via mobile-defect migration along and between network segments. Plastic flow can result from defect loss at dangling ends. Author

N89-13586# Tokyo Metropolitan Univ. (Japan).
DYNAMICS OF POLYMERS IN POLYDISPERSE MELTS Abstract Only
Masao Doi *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 12 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The dynamic behavior of a mixture of two homopolymers with narrow molecular weight distribution is analyzed on the basis of the concepts of reptation and constraint release. It is proposed that constraint release causes not only the tube renewal (the relaxation of the tube), but also tube dilation (the enlargement of the effective tube diameter). A general scheme of accounting for these effects is given. The diffusion constants and the relaxation modulus of the mixture is predicted as a function of the molecular weight of each component and their mixing ratio. Author

N89-13587# California Univ., Santa Barbara.
POLYMER MELT DYNAMICS IN THE PRESENCE OF REVERSIBLE CHAIN SCISSION REACTIONS Abstract Only
Michael E. Cates *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987

p 13 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Within the framework of the tube model, a theory is presented of stress relaxation in systems of concentrated polymers that can undergo reversible chain-scission reactions on experimental time scales. The model should be relevant to the description of flexible surfactant micelles, end-linking functionalized polymers, and equilibrium polymers such as liquid sulfur at high temperatures. Author

N89-13588# Dow Chemical Co., Midland, Mich.
DYNAMICS OF STYRENE-ISOPRENE-STYRENE TRIBLOCK COPOLYMERS SYSTEMS CONTAINING SMALL AMOUNTS OF DIBLOCK AND HOMOPOLYMER MOLECULES
Charles A. Berglund *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 14 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Triblock copolymers with polystyrene endblocks (15 percent) and polyisoprene midblocks form elastomers at temperatures between the glass transitions of the blocks due to pseudo-crosslinking by the dispersed polystyrene domains. These systems are rarely composed entirely of perfect triblock molecules, however, and the viscoelastic properties are influenced by the presence of small amounts of other molecules which are, or can behave as, either a diblock or homopolymer. The effects of these species can be explained using the concepts of reptation and constraint release. Both homopolymer and diblock are found to contribute to dynamic mechanical loss in the rubbery plateau for isochronal data. The homopolymer relaxes at a lower temperature than the diblock since it is free to reptate while the diblock must relax by constraint release. Stress relaxation data indicate that relaxation from the rubbery plateau in these systems occurs by a two step process, probably involving endblock diffusion out of polystyrene domains and reptation of the entire chain through the matrix. Author

N89-13589# Tennessee Univ., Knoxville.
NORMAL MODE ANALYSIS OF LATTICE MODEL POLYMER CHAINS Abstract Only
Charles C. Crabb, David F. Hoffman, Michelle Dial, and Jeffrey Kovac *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 15 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The dynamic behavior of simple-cubic and face-centered-cubic lattice model polymer chains was simulated using a Monte Carlo method. The chain relaxation was analyzed using the Rouse normal coordinates. It was found that normal mode analysis accurately describes chain relaxation at all concentrations studied. No cross-correlations are observed between modes. The chain length dependence on the relaxation times is found to be a function of both concentration and mode number. Some differences between lattices are also observed. Author

N89-13590# Minnesota Univ., Minneapolis.
REPTATION IN ANISOTROPIC MEDIA Abstract Only
William W. Merrill and Matthew Tirrell *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 16 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The effect of orientation on simple reptation (i.e., neglecting tube length fluctuations and constraint release) was investigated. Specifically, tube segments created at time t' after a step strain at time zero are no longer isotropically oriented as per Doi and Edwards but rather are oriented to an extent alpha of the mean orientation in the sample existing at t'. The change in the initial Hermanns orientation function G(0) with initial strain was assumed known, thus only the change in the shape and scale of the time relaxation spectrum is addressed. The decay of the Hermanns orientation function G(t) in the terminal zone for chains reptating according to this model was determined analytically in the case of proportional coupling. This solution provides an upper and lower bound for G(t) in the case of coupling decreasing with decreasing G(t). Author

N89-13591# Minnesota Univ., Minneapolis.
DIFFUSION OF BRANCHED AND LINEAR POLYMERS IN CONCENTRATED SOLUTIONS Abstract Only
Timothy P. Lodge *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 17 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The mechanisms of motion available to macromolecules in concentrated systems are of fundamental importance to synthesis, processing, application, and molecular characterization. The technique of dynamic light scattering from isorefractive ternary solutions permits precise measurement of translational diffusion coefficients for trace amounts of a probe polymer in solution. The variables of interest include the molecular weight and chain architecture of the probe, and the concentration and molecular weight of the invisible surrounding matrix chains. Author

N89-13592# Max-Planck-Inst. fuer Polymerforschung, Mainz (West Germany).
CO-MO-MODEL: A MODEL OF COOPERATIVE MOTIONS IN DENSE POLYMER SYSTEMS Abstract Only
T. Pakula and S. Geyler *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 18 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

A microscopic model of cooperative motions in condensed polymer systems is presented. The mechanism assumed consists in collective replacements of molecular subsegments within closed loops of motion. The model is applied to computer simulation of polymer chain motions on a lattice with all sites occupied. Results related to static properties and to self diffusion of linear and cyclic chains are reported. Monodisperse systems with chains of various lengths (up to 512 monomer units) were considered. It is shown that in equilibriated amorphous dense systems linear chains satisfy the Gaussian statistics contrary to cyclic chains which seem to be slightly more collapsed than the Gaussian statistics for ring molecules predicts. Author

N89-13593# Cambridge Univ. (England).
DYNAMICS OF REVERSIBLY CROSSLINKED CHAINS Abstract Only
L. G. Baxandall *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 19 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The dynamics and linear viscoelastic response of a polymer chain bound by reversible crosslinks to a (phantom) network are considered in a mean field picture. Reversible crosslinks are viewed as entities which while intact fix a segment of polymer in space but which spontaneously break and reform to allow the point of attachment and hence the polymer to move. Particular results for small numbers (2, 3, and 4), as a model for ionomer gels, and for large numbers of crosslinks, comparing with Rouse chain dynamics, are given. Author

N89-13594# Osaka Univ. (Japan).
ENTANGLEMENT IN BLENDS OF MONODISPERSE STAR AND LINEAR POLYSTYRENES Abstract Only
Hiroshi Watanabe, Hirotsugu Yoshida, and Tadao Kotaka *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 20 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Viscoelastic properties of binary blends of low and high molecular weight monodisperse polystyrenes (designated as 1- and 2-chains, respectively) were investigated. Linear polystyrenes (PS) were used as the 1-chain (with molecular weight M sub 1), and star and/or linear PS were used as the 2-chain (with molecular weights M sub 2). In the dilute blends examined, the content w

sub 2 of the 2-chain was kept small so that only the entanglement between the 1- and 2-chains (1-2 entanglement) affected the relaxation of the 2-chain. Author

N89-13595# Cambridge Univ. (England).
G-POLYMERS IN THE MELT
T. C. B. McLeish *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 21 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The tube model of polymer melts was successfully applied to linear and star-shaped polymers. It is interesting to extend the approach to the case of H-shaped polymers because these are the simplest that contain polymer chain between branch points. This has important molecular and rheological consequences, which are presented. Particularly interesting is the response in extensional deformation, which is related to the behavior of branched polyethylenes in converging flow. Author

N89-13596# Dow Chemical Co., Midland, Mich.
UNITING REPTATION THEORY WITH ENTANGLEMENT NETWORK MODELS TO DESCRIBE THE MELT DYNAMICS OF LINEAR POLYMERS Abstract Only
Bernard J. Meister *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 22 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

A rheological model is proposed for describing the melt dynamics of linear polymers. This is an entanglement model where entanglements are assumed to be formed by reptation. Entanglements are removed by both normal diffusional reptation and by forced reptation in a deformational field. Constraint release is handled by calculating the probability of a given chain end being the shortest chain end and therefore the reptational segment at the entanglement junction. Predictions of the zero shear viscosity and steady state compliance of blends of monodisperse polymers are closer to published data than any previous models. No constants are introduced to fit the data beyond the monomeric friction coefficient, entanglement length, and measured time-temperature shift factors which all cancel out in comparison with the blend data. Author

N89-13597# California Univ., San Diego.
THE MOBILITY OF A REPTATING CHAIN INCREASES WITH STRETCHING Abstract Only
Bruno H. Zimm *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 23 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

When a steady force is uniformly applied to all segments of a reptating chain, the chain moves in response. A computer simulation is used that shows that the speed of this motion, measured as the velocity of the center of mass, increases if the chain is first stretched by another force applied to the ends. Author

N89-13598# Cornell Univ., Ithaca, N.Y.
PHOTON CORRELATION SPECTROSCOPY FROM DILUTE POLYMER-POLYMER MIXTURES Abstract Only
Melia Rodrigo and Claude Cohen *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 24 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The molecular weight, concentration, and temperature dependences of the initial decay of the light scattering photon correlation from dilute mixtures of polystyrene in polymethylphenyl siloxane was examined. The q sup 2-dependence previously reported on these mixtures was observed. For polystyrene molecular weights substantially larger than the polymethylphenyl siloxane matrix, the infinite dilution limit of the diffusion coefficient extracted from the initial decay appears to follow a molecular weight dependence close to M sup 0-3. For the very dilute mixtures studied, the thermodynamic interaction effect is very small and the changes in the diffusion appears to due to the effects of concentration on the friction coefficient. The temperature dependence of the initial decay rate of the correlation deviates from an Arrhenius behavior as the coexistence curve of the mixture is approached. Author

N89-13599# Ecole Superieure de Physique et de Chimie Industrielles, Paris (France).
EXPERIMENTAL EVIDENCES OF RELAXATION PROCESSES OF THE DOI-EDWARDS MODEL AND FURTHER PROBLEMS Abstract Only
Jean Francois Tassin and Lucien Monnerie *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 25 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The relaxation of the average orientation of stretched polystyrene chains was studied by infrared dichroism over a large time domain for different narrow distribution samples of different molecular weights. The behavior at short times appears to be independent of the molecular weight and was attributed to the local relaxation process between entanglements. The behavior at longer times exhibits molecular weight effects and can be interpreted by the retraction and reptation motions of the Doi-Edwards theory. The existence of these relaxation processes has become more apparent through the study of the relaxation of a chain segment as a function of its location along the chain using isotopically labeled block copolymers. A more rapid relaxation of chain ends was experimentally observed and accounted for by considering the retraction and reptation processes. Author

N89-13600# Cornell Univ., Ithaca, N.Y.
MOLECULAR REPTATION FROM THE MELT TO A GROWING CRYSTAL FACE OF PE Abstract Only
Rade Ognjanovic and James N. Hay *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 26 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The effect was studied of molecular weight, branch concentration, branch type and branch sequence distribution of linear low density PE crystallization kinetics. Suitable fractions of PE were obtained by temperature rising elution fractionation and gel permeation chromatography techniques. Differential scanning calorimetry and polarized light microscopy were then used to follow the growth of spherulites and the crystallization kinetics. The crystallization kinetics models of Avrami, Evans and Hoffman were applied to the data and effects due to the four molecular morphologies above were noted. Author

N89-13601# Cornell Univ., Ithaca, N.Y.
KINETICS OF FORMATION OF THE DIFFUSE INTERFACE BETWEEN PARTIALLY COMPATIBLE POLYMERS Abstract Only
M. Rafailovitch, J. Sokolov, G. Krausch, R. Mills, R. A. L. Jones, and J. Klein *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 27 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Rutherford Backscattering was used to measure the concentration profiles between solution chlorinated polyethylene (SCPE) and polymethyl methacrylate (PMMA) after annealing at various temperatures in both the one phase region and the two phase region of the phase diagram. A diffuse interface was observed in both regions of the phase diagram; its width could be characterized by a diffusion coefficient like parameter, whose temperature dependence has a maximum at a temperature markedly above the critical solution temperature of the blend. In the one phase region this parameter is simply interpreted in terms of the (concentration dependent) mutual diffusion coefficient of the blend; above the LCST it reflects not only diffusion in the

miscible region but also the approach to the equilibrium interface thickness between the two immiscible phases. Author

N89-13602# Akron Univ., Ohio.
A LOOP MODEL OF ENTANGLEMENT IN THE MELT Abstract Only
A. MacArthur and D. McIntyre *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 28 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

Entanglement in high molecular weight polymers is considered both experimentally and theoretically. Thus polymer entanglements are viewed as topological interactions of strands not involving their ends, or loop interactions. Both static and dynamic models were developed and are applied to experiments on isolated polymer chains and polymer melts. A scheme for analyzing tangle projections was developed and leads to: (1) an ability to determine the type of entanglement in computer walks, (2) sufficient conditions on the crossing list for tieability, (3) an interaction matrix that rationalizes blobs, and (4) an alternative method for analyzing knots in general that provides insight into the structure of known knots. Author

N89-13603# National Research Council of Canada, Ottawa (Ontario). Industrial Materials Research Inst.
ULTRASONIC CHARACTERIZATION OF POLYSTYRENE AS A FUNCTION OF TEMPERATURE AND PRESSURE Abstract Only
L. Piche and F. Massines *In* Michigan Molecular Inst., The 1987 MMI International Symposium on Polymer Melt Dynamics 1987 p 29 (For primary document see N89-13574 05-27)
Avail: NTIS HC A03/MF A01 CSCL 11I

The propagation was studied of 3 MHz ultrasonic waves in polystyrene. The specific volume (V) is measured together with the velocity (v) and the attenuation (a) of shear and longitudinal waves, in the temperature range from - 150 C to 200 C at pressures extending to 1Kbar. These measurements are translated in terms of storage and loss moduli (longitudinal and shear). For all values of pressure, the general behavior of measurements made as a function of temperature is similiar. The specific volume curve allows to define the glass transition zone. Author

N89-13604*# HITCO, Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5834 LOT NO. 2
[1986] 143 p
(Contract NAS8-36298)
(NASA-CR-179417; NAS 1.26:179417; D-09275) Avail: NTIS HC A07/MF A01 CSCL 11B

Filler testing, particle analysis, resin testing, fabric testing, and prepreg testing results for FM 5834 Lot 2 are presented in graphs and tables. B.G.

N89-13605# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
THE CHARACTERIZATION OF AMORPHOUS Al2O3 BY EXTENDED ENERGY LOSS FINE STRUCTURE (EXELFS) ANALYSIS
P. S. Sklad, P. Angelini, and J. Sevely (Centre National de la Recherche Scientifique, Toulouse, France) 1988 3 p Presented at the MAS/EMSA Microbeam Analysis Conference, Milwaukee, Wis., 7 Aug. 1988
(Contract DE-AC05-84OR-21400)
(DE88-007484; CONF-880841-6) Avail: NTIS HC A02/MF A01

Recently an investigation of the effects of ion implantation on the microstructure and properties of Al2O3 has revealed differences in the response of various forms of amorphous Al2O3 to post-implantation annealing. Specifically the amorphous implanted layer in a specimen implanted with a stoichiometric ratio of aluminum and oxygen at -185 C (Al2O3- Al,O) recrystallized into a dual phase microstructure consisting of gamma-Al2O3 and alpha-Al2O3. In contrast the amorphous layer in a specimen implanted with iron at -185 C (Al2O3-Fe) recrystallized completely to epitaxial alpha-Al2O3. In order to understand these differences EXELFS analysis has been performed on several types of Al2O3 including Al2O3-Al,O and Al2O3-Fe, as well as single crystal alpha-Al2O3 and crystalline gamma-Al2O3. Disko, Bourdillon, and Sevely have also reported EXELFS studies of Al2O3. All measurements were made on backthinned specimens prepared using established procedures. Comparison of the results revealed several differences. The Al-O interatomic distances measured in the two forms of amorphous Al2O3 differed by approximately 0.01 nm, regardless which edge was used for the analysis. Moreover the value measured for Al2O3-Al,O agrees with the value measured for crystalline gamma-Al2O3, the form into which it recrystallizes. In a similar way the Al-O distance measured in the amorphous Al2O3-Fe agrees with the value measured for crystalline alpha-Al2O3, the form into which it recrystallizes. Investigation of the relationship between these underlying structural differences and recrystallization behavior continues. DOE

N89-13606*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5064J TEST LOT 5 (H)
[1986] 57 p
(Contract NAS8-36298)
(NASA-CR-179411; NAS 1.26:179411; D-09337) Avail: NTIS HC A04/MF A01 CSCL 11B

Test results for FM 5064J Lot No. 5 (H) for filler testing, resin testing, fabric testing, and prepreg testing are presented in tabular and graphic format. B.G.

N89-13607*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5055B LOTS 4 AND 5
[1986] 121 p
(Contract NAS8-36298)
(NASA-CR-179413; NAS 1.26:179413; D-09313; D-09335) Avail: NTIS HC A06/MF A01 CSCL 11B

Test results for FM 5055B Lot No. 4 and 5 for filler testing, resin testing, fabric testing, and prepreg testing are presented in tabular and graphic format. B.G.

N89-13608# Illinois Univ., Urbana. Dept. of Chemistry.
POLYSILICIC ACID ESTERS AS PRECURSORS TO NEW CERAMIC MATERIALS Ph.D. Thesis
Dean Michael Millar 1987 169 p
(Contract DE-AC02-76ER-01198)
(DE88-014627; DOE/ER-01198/T18) Avail: NTIS HC A08/MF A01

Two simple siloxane ester chains, (Si2O)(OCH3)6 and (Si3O2)(OCH3)8, and a polysilicic acid ester (Si8O12) core, (Si8)12)(OCH3)8 were prepared. Synthesis of the di- and trosiloxane esters was achieved by reaction of their commercially available chlorosiloxane precursors with either CH3ONO or HC(OCH3)3. Similar reactions of (Si8O12)Cl8, prepared by photochlorination of (Si8O12)H8, with CH3ONO or HC(OCH3)3 produce (Si8O12)(OCH3)8. Si-29 NMR and single-crystal X-ray analysis were used. Hydrolysis-condensation (Si2O)(OCH3)6 and (Si3O2) (OCH3)8 produced monomer degradation at low rates. Similar experiments on (Si8)12)(OCH3)3 indicated that these reactions proceeded without cage degradation. Si-29 FTMAS and CPMAS NMR showed that gels prepared from Si(OCH3), (Si2O)(OCH3)6, and (Si3O2) (OCH3)8 exhibited similar distributions of Q sup 2, Q sup 3, and Q sup 4/ sites. Observation of Q sup 2 silicon centers demonstrated that degradation of the (Si8O12) cage had occurred. Further distinctions between the gels were made, based on spin-lattice relaxation for the Q sub 4 silicons. A series of (Si8O12) -based molecules bearing a single reactive site were synthesized in order to study condensation behavior of the Q sup 3 (Si8O12) centers. (Si8O12)(OSi(CH3)3)7H was prepared from (Si8O12)H8. Reaction of this monosilane with (CH3)3SnOCH3 produced (Si8O12) (OSi CH3)3)7Osn(CH3)3. Hydrolysis of the stannoxy adduct with HCl yielded the stable, crystalline monosilicic acid (Si8O12)OSi(CH3)3)7OH. Silicic acid self-condensation was

found to be catalyzed by bases but not by acids. No evidence of cage degraded products were observed. The monosilicic acid was found to readily react with (Si8O12) (OCH3)8 to yield the mixed dimer ((CH3)3SiO)7(Si8O12)(OCH3)7. DOE

N89-13609*# Old Dominion Univ., Norfolk, Va. Dept. of Chemical Sciences.
GAS PERMEATION MEASUREMENTS ON SMALL POLYMER SPECIMENS Final Report, period ending 31 Dec. 1987
Karen S. Burns and John D. VanNorman Feb. 1988 68 p
(Contract NAS1-17993)
(NASA-CR-182439; NAS 1.26:182439) Avail: NTIS HC A04/MF A01 CSCL 11B

Mass spectrometry was used to measure oxygen and nitrogen permeabilities while polarography was used to measure oxygen permeabilities for several contact lens materials. Applicable sample holders were designed and fabricated to accomodate curved and flat specimens. A prepared standard was used to calibrate the mass spectrometric analyses. The oxygen permeability values determined by mass spectrometry were significantly greater than those determined by polarography. This was attributed to the phase boundary phenomena and the limiting oxygen permeance of water inherent in the polarographic technique. Polarographic values determined were in good agreement with proprietary values obtained by polarography, with the exception of one material. Author

N89-13610*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5839 TEST LOTS 1, 2, 3, 5, 2R
[1986] 314 p
(Contract NAS8-36298)
(NASA-CR-179420; NAS 1.26:179420) Avail: NTIS HC A14/MF A01 CSCL 11B

Test results for FM 5839 Lot No. 1, 2, 3, 5, and 2R for filler testing, resin testing, fabric testing, and prepreg testing are presented in tabular and graphic format. B.G.

N89-13611*# HITCO, Santa Ana, Calif. Materials Div.
FINGERPRINT TEST DATA REPORT: FM 5055B LOT NO. 2
[1986] 213 p
(Contract NAS8-36298)
(NASA-CR-179418; NAS 1.26:179418; D-09274) Avail: NTIS HC A10/MF A01 CSCL 11B

Filler testing, particle analysis, resin testing, fabric testing, and prepreg testing results for FM 5055B Lot 2 are presented in graphs and tables. B.G.

N89-13612*# United States Polymeric Chemicals, Inc., Santa Ana, Calif. Materials Div.
STATISTICAL CHARACTERIZATION OF CARBON PHENOLIC PREPREG MATERIALS, VOLUME 2 Final Report
1 Apr. 1988 285 p
(Contract NAS8-36298)
(NASA-CR-179415; NAS 1.26:179415) Avail: NTIS HC A13/MF A01 CSCL 11B

Specifications for fillers, resins, fabrics, and prepregs are provided. Chemical, physical, and miscellaneous test methods are described. B.G.

N89-13613# Texas Univ., Arlington. Dept. of Chemistry.
ELECTRONIC AND IONIC TRANSPORT IN POLYMERS Technical Report No. 7
Fei Wang and John R. Reynolds 12 Jul. 1988 13 p Submitted for publication
(Contract N00014-86-K-0769)
(AD-A197108) Avail: NTIS HC A03/MF A01 CSCL 07D

A new electroactive and soluble polymer, based on nickel bisdithiolene linkages along the polymer main chain, has been prepared. This polymer, poly(bis-(4-oxystyryldithiolene)nickel) (PBOSD-Ni), can be dissolved in both aqueous and organic solvents in the reduced form. UV-VIS spectra show features typical to comparable nickel bisdithiolene complexes and the (NiL2(2-) yields (NiL2)(1-) yields (Nil2)(0) oxidation states are observed electrochemically. GRA

N89-13614# Texas Univ., Arlington. Dept. of Chemistry.
ELECTRONIC AND IONIC TRANSPORT IN POLYMERS Technical Report No. 8
John R. Reynolds, N. S. Sundaresan, Martin Pomerantz, Sanjay Basak, and Charles K. Baker 12 Jul. 1988 33 p
(Contract N00014-86-K-0769)
(AD-A197193) Avail: NTIS HC A03/MF A01 CSCL 07D

A self-doped copolymer of pyrrole, poly(pyrrole-co(3-(pyrrole-1-yl)propanesulfonate), in which the charge compensating counterion is covalently bound to the polymer main chain has been prepared and the charge transport in the polymer during redox switching has been investigated using chronocoulometry and microgravimetry as a function of supporting electrolyte. The results are compared with the behavior of polypyrrole under similar conditions. It is shown that within this new family of materials called self-doped conductive polymers ion mobility is restricted to cationic species and thus the polymer can be viewed as an ion specific membrane. This is in contrast to the case of polypyrrole where a more complex behavior prevails. The charge passed during the chronocoulometric experiment varies as t superscript alpha where 0.2 less than alpha less than 0.9 and the ion mobility is sensitive to cation size. GRA

N89-13615# Vermont Univ., Burlington. Dept. of Chemistry.
INORGANIC POLYMERS OF THE MAIN-GROUP ELEMENTS Technical Report No. 10
Christopher W. Allen 8 Jul. 1988 15 p
(Contract N00014-85-K-0058)
(AD-A197392) Avail: NTIS HC A03/MF A01 CSCL 07F

A brief introduction to the chemistry of inorganic polymers of the main-group elements is presented using poly(siloxanes), poly(phosphazenes), poly(organosilanes) and poly(sulfur nitride) as examples. Topics include: synthesis, ring/chain equilibria, high and low temperature behavior, reactivity and property design, electronic structure. GRA

N89-13616# Utah Univ., Salt Lake City. Dept. of Chemistry.
TEMPERATURE-INDUCED CHANGES IN REVERSED-PHASE CHROMATOGRAPHIC SURFACES: C8 AND C9 POLYMERIC LIGANDS Technical Report No. 10, Sep. 1987 - Jun. 1988
J. W. Carr and J. M. Harris 15 Jul. 1988 26 p Submitted for publication
(Contract N00014-85-K-0712)
(AD-A197443) Avail: NTIS HC A03/MF A01 CSCL 07F

The temperature-dependent polarity of polymeric C8 and C9 stationary phases, preconditioned with acetonitrile and then contacted with water, is studied using the fluorescence of sorbed pyrene as a probe. The fluorescence vibronic band ratio, sensitive to the polarity of the probe surroundings, shows a temperature-dependent hysteresis which is indistinguishable from the retention behavior of these materials. The stationary phase polarity decreases when passing through the hysteresis, which is consistent with the loss of conditioning solvent from the interface but inconsistent with an extended structure for the alkyl ligands. Solvent retention in the stationary phase and its temperature dependence appears to require local ordering of the polymer phase. GRA

N89-13617# Kent State Univ., Ohio. Liquid Crystal Inst.
PHASE SEPARATION OF LIQUID CRYSTALS IN POLYMERS
John L. West 11 Jul. 1988 13 p
(Contract N00014-86-K-0772)
(AD-A197459; TR-7) Avail: NTIS HC A03/MF A01 CSCL 20F

New optoelectronic materials based on polymer dispersed liquid crystals (PDLC) show great potential for application in displays, temperature sensors, optical computing and for solar energy control. Liquid crystals, thermoset or thermoplastic materials are described. PDLC materials may be formed by several different

processes. The liquid crystal may be dissolved in low molecular weight polymer precursors, in a thermoplastic melt or with a thermoplastic in a common solvent. Subsequent polymerization, cooling of the polymer melt or solvent evaporation lead to liquid crystal immiscibility, droplet formation and growth, and polymer gelation. The optoelectronic properties of these materials are affected by the droplet morphology. Specific examples are presented for each of these processes and it is demonstrated how the droplet morphology for density, and thus device performance, can be controlled by each method. GRA

N89-13618# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.

THE EFFECTS OF CHEMISTRY AND CRYSTAL STRUCTURE ON THE LUBRICATION PROPERTIES OF SPUTTERED MoS2 FILMS

Paul D. Fleischauer and Reinhold Bauer 25 May 1988 35 p Prepared in cooperation with Air Force Space Div., Los Angeles, Calif.

(Contract F04701-85-C-0086)

(AD-A197460; TR-0086A(2945-03)-3; SD-TR-88-36) Avail: NTIS HC A03/MF A01 CSCL 11F

Lubricating films of MoS2 have been prepared by sputter deposition onto steel substrates maintained at different temperatures. The surface chemical compositions and bulk structural properties of the films, before and after rubbing for various times in dry nitrogen gas, were determined by X-ray photoelectron spectroscopy and by X-ray diffraction, respectively. Film thicknesses, densities, and morphologies were also measured. Differences in these properties for the films prepared under different conditions provide insight into the mechanisms of film lubrication and failure. It is proposed that lubrication by MoS2 films occurs through intercrystalline slip and that there is an optimal crystalline size that provides maximum wear life under particular application conditions. Methods are suggested for improving film performance, based on particle/crystalline size and lattice spacing arguments and on the electronic properties of MoS2 and related compounds. GRA

N89-13619# Chemical Research and Development Center, Aberdeen Proving Ground, Md.

REVIEW OF PREPARATION AND PROPERTIES OF POLYMERS FROM COPOLYMERIZATION OF APROTIC ACRYLIC MONOMERS WITH PROTIC ACRYLIC MONOMERS Technical Report, Jun. 1984 - Feb. 1988

Seok H. Hong and Vincent M. McHugh Jul. 1988 35 p

(AD-A197467; CRDEC-TR-88093) Avail: NTIS HC A03/MF A01 CSCL 07F

Selected literature on the preparation and properties of copolymers from aprotic acrylic monomers with protic acrylic monomers was reviewed. Emphasis was placed on monomers such as acrylic acid, methacrylic acid, 1-vinyl-2-pyrrolidone, alklaminoalkyl acrylate, and alkylaminoalkyl methacrylate. The resulting polymers were mostly hydrophilic and were usually water-soluble polyelectrolytes. High molecular weight polymers and their properties are also emphasized in this review. GRA

N89-13620*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

LIGHTWEIGHT CERAMIC INSULATION AND METHOD Patent Application

David J. Green, inventor (to NASA) (Rockwell International Corp., Houston, Tex.) 30 Jun. 1988 8 p

(NASA-Case-MSC-20782-1; NAS 1.71:MSC-20782-1; US-Patent-Appl-SN-213392) Avail: NTIS HC A02/MF A01 CSCL 11C

The invention relates to a lightweight, high temperature resistant insulation and a process for making it. The insulation can be used in ceramic or metallurgical industrial applications which require high temperature insulation as well as the aerospace field for space vehicle insulation. This invention is for a freeze-dried powder which can be formed into low density, ceramic insulation and the process for making the powder. Water soluble salts are used which after heating or chemical conversion can be become high temperature ceramic. The salt solution is about 75 percent to about 99.5 percent water. The solution containing the salts is sprayed into a cryogenic liquid. The rapid freezing of the relatively dilute salt solution produces a solid with a fine microstructure. The frozen solids are placed in a vacuum chamber and freeze dried to remove the ice. The resultant solid is a powder containing porous aggregates. The relative percentage of water will control the solids in the aggregates. The porous powder is formed using casting or molding techniques. The pressing process is controlled to achieve the desired final density. NASA

N89-13621*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.

THERMAL BARRIER COATING LIFE PREDICTION MODEL DEVELOPMENT Final Report

R. V. Hillery, B. H. Pilsner, R. L. McKnight, T. S. Cook, and M. S. Hartle Nov. 1988 150 p

(Contract NAS3-23493)

(NASA-CR-180807; NAS 1.26:180807; R87-AEB586) Avail: NTIS HC A07/MF A01 CSCL 11C

This report describes work performed to determine the predominat modes of degradation of a plasma sprayed thermal barrier coating system and to develop and verify life prediction models accounting for these degradation modes. The primary TBC system consisted of a low pressure plasma sprayed NiCrAlY bond coat, an air plasma sprayed ZrO2-Y2O3 top coat, and a Rene' 80 substrate. The work was divided into 3 technical tasks. The primary failure mode to be addressed was loss of the zirconia layer through spalling. Experiments showed that oxidation of the bond coat is a significant contributor to coating failure. It was evident from the test results that the species of oxide scale initially formed on the bond coat plays a role in coating degradation and failure. It was also shown that elevated temperature creep of the bond coat plays a role in coating failure. An empirical model was developed for predicting the test life of specimens with selected coating, specimen, and test condition variations. In the second task, a coating life prediction model was developed based on the data from Task 1 experiments, results from thermomechanical experiments performed as part of Task 2, and finite element analyses of the TBC system during thermal cycles. The third and final task attempted to verify the validity of the model developed in Task 2. This was done by using the model to predict the test lives of several coating variations and specimen geometries, then comparing these predicted lives to experimentally determined test lives. It was found that the model correctly predicts trends, but that additional refinement is needed to accurately predict coating life. Author

N89-13622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BRITTLENESS AND TOUGHENING OF CERAMICS

Guo Jingkun 21 Jul. 1988 16 p Transl. into ENGLISH from Guisvanyan Xuebao (Peoples Republic of China), v. 15, no. 5, Oct. 1987 p 385-393

(AD-A198717; FTD-ID(RS)T-0419-88) Avail: NTIS HC A03/MF A01 CSCL 11B

Improving the brittleness of ceramic materials has long been a problem of concern to ceramists. Fiber-reinforcing and zirconia phase transformation toughening have proven effective approaches in practice for improving the brittleness as well as the strength of ceramics. This paper will briefly discuss some problems in the study of the above two approaches. The importance of chemical compatibility between fiber and matrix is pointed out in the study of fiber-reinforced ceramic composite materials; the matches of the two in thermal expansion and elastic modulus can not be neglected either, and the moderate bonding of the two boundary surfaces is considered appropriate. GRA

N89-13623# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesive and Sealant Science.

A BEAM TEST FOR ADHESIVES Final Report, 1 Sep. 1987 - 31 Jul. 1988

Valerie F. Fior and Hal F. Brinson 31 Jul. 1988 216 p
(Contract N00014-82-K-0185)
(AD-A198803; VPI-E-88-21; CASS/ESM-88-8) Avail: NTIS HC A10/MF A01 CSCL 11A

The strength of materials solution for a new bonded cantilever beam test specimen to determine adhesive shear properties is reviewed and discussed. A parametric analysis for the adhesive shear stress and for the end deflection reveals the specimen dimensions required for reliable bonded adhesive shear properties determination. Recommendations are provided for conducting reproducible tests. A pure and quasi-uniform shear test for stiff adhesives is proposed. Analytical solutions are compared with Finite Element solutions from VISTA and NOVA for the stresses in the adhesive. It appears that the assumption of pure shear is nearly valid even for very stiff and/or very thick adhesives. In order to increase the end point deformations for stiff adhesives, a modified specimen is proposed. Three-dimensional effects through the thickness of the adhesive layer are studied with the program ABAQUS. GRA

N89-13624# Stanford Univ., Calif. Lab. of Physics.
ELASTIC DOMAIN WALL WAVES IN FERROELECTRIC CERAMICS AND SINGLE CRYSTALS Final Report, 1 Feb. 1979 - 31 Jan. 1988
B. A. Auld Jul. 1988 240 p
(Contract N00014-79-C-0222)
(AD-A198910) Avail: NTIS HC A11/MF A01 CSCL 20B

This report reviews research on acoustic guided waves along poling transitions in counter-poled ferroelectric ceramics, signal processing with programmable electrostrictive surface acoustic wave (SAW) transducers, improved performance and mode suppression in periodic piezoelectric/epoxy composites, programmable acoustic and optical gratings in ferroelastic crystals. It concludes with projections and needs for future work on electrostrictive transducers and periodic composites for hydrophone applications. Particular attention is paid to new materials and structures for the transducers, and to the potential of periodic composites for spatial filtering of turbulent boundary layer noise in hydrophones. GRA

N89-13625# Army Lab. Command, Watertown, Mass. Material Technology Lab.
EVALUATION OF TRANSPARENT POLYMERS FOR CHEMICALLY HARDENED ARMY SYSTEMS Final Report
Janice J. Vanselow and Alex J. Hsieh Jul. 1988 24 p
(AD-A198968; MTL-TR-88-24) Avail: NTIS HC A03/MF A01 CSCL 07F

Polymers being considered for use as transparent armor are evaluated for resistance to degradation in a chemical environment and consequently for their ability to be decontaminated. Immersion of these materials in organic liquids chosen as simulants for the CW agents, as well as the decontaminant DS2, is performed as a preliminary screening. These materials include polycarbonate (PC), four forms of polymethyl methacrylate (PMMA), a developmental polyurethane, and polyetherimide (PEI). Environmental stress crazing and cracking (ESC) tests are also used to determine the chemical resistance of PC. The use of linear elastic fracture mechanics (LEFM) for determining the fracture toughness of several of these transparent polymers is illustrated. The development of a crack propagation study based on LEFM is demonstrated with PEI. Ballistic testing is also reported on to further characterize the mechanical properties of these materials. GRA

N89-13626# Northwestern Univ., Evanston, Ill. Materials Research Center.
BASIC STUDIES OF POLYMER ELECTROLYTES SUITABLE FOR ADVANCED ELECTROCHEMICAL DEVICES Final Report, 1 Jun. 1980 - 30 Apr. 1988
Duward F. Shriver and D. H. Whitmore Aug. 1988 6 p
(Contract N00014-80-C-0532)
(AD-A198974; TR-21) Avail: NTIS HC A02/MF A01 CSCL 07F

New polymer electrolytes were prepared and studied by complex impedance spectroscopy, pulsed field gradient, and MAS NMR. A new class of polymeric mixed ionic-electronic conductors was also prepared and studied. GRA

N89-13627# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
SYNTHESIS AND CHARACTERIZATION OF BiCaSrCuO AND BiSnCaSrCuO SUPERCONDUCTING CERAMICS
John H. Miller, Jr., William E. Hatfield, Brian R. Rohrs, Martin L. Kirk, Joanne L. Perkinson, Kathleen L. Trojan, John D. Hunn, Zu Hua Zhang, and William J. Riley 20 Sep. 1988 10 p Presented at the International Conference on the First Two Years of High Temperature Superconductivity, Tuscaloosa, Al., 11-13 Apr. 1988 Submitted for publication
(Contract N00014-86-K-0608)
(AD-A198988; TR-32) Avail: NTIS HC A02/MF A01 CSCL 11B

Magnetic susceptibility measurements, resistance measurements, Rutherford backscattering, scanning electron microscopy, and energy dispersive X-ray analyses were utilized in order to determine the effects of composition and firing conditions on the properties of the Bi-Ca-Sr-Cu-O superconducting ceramics. GRA

N89-13628# International Business Machines Corp., San Jose, Calif. Research Center.
LASER DESORPTION MASS SPECTROMETRY OF SUBSTITUTED SILANE HIGH POLYMERS Technical Report No. 17
T. Magnera, V. Balaji, R. Sooriyakumaran, R. D. Miller, and J. Michl 1 Aug. 1988 72 p Submitted for publication
(Contract N00014-85-C-0056)
(AD-A199098) Avail: NTIS HC A04/MF A01 CSCL 07C

Laser ablation of a variety of polysilanes at 308 nm using fluences of 150 to 250 mJ/sq.cm. per pulse, well above the photoablation threshold, is a photothermal process and yields products identical to those obtained in vacuum pyrolysis with a CO2 laser. Unsaturated hydrocarbon products characteristic of the side chains have been identified unequivocally. Silicon-containing products have not been identified individually and it is proposed that they are a mixture of cyclic carbonsilanes, mostly containing no more than two or three silicon atoms linked to each other. A reaction mechanism for the ablation process is proposed and involves no previously unknown reaction steps. The results demonstrate that laser-desorption mass spectrometry will be a good analytical tool for the characterization of this class of polymers. Due to the high volatility of the hydrocarbons, the presence of even quite long side chains on the polymer backbone need not be a source of concern in the applications of the photoablation process. GRA

N89-13629# Thermo Electron Corp., Waltham, Mass.
THERMIONIC TECHNOLOGY PROGRAM, FISCAL YEAR 1986 Final Technical Report
Velma P. Cone and John B. Dunlay Dec. 1987 89 p
(Contract DE-AC03-86SF-15955)
(DE88-003944; DOE/SF-15955/1; TE-4400-227-87) Avail: NTIS HC A05/MF A01

During FY 1986, the Thermionic Technology Program at Thermo Electron Corporation concentrated on advancing the development of cermet sheath insulators and additive converters. Both development efforts were based on the thermionic technology established by thermionic reactor programs during the 1960's and early 1970's. Improved sheath insulators and additive converters were fabricated during FY 1986 and delivered to Rasor Associates Incorporated, for extensive testing and evaluation. The most promising cermet fabrication process changed from dry ceramic powder coating of niobium spherical particles to the use of water-based slurries of ceramic powder and fine, irregularly shaped, niobium powder. Slurry processing is much more controlled and reproducible. The fabrication of crack-free, fully dense yttria alumina garnet (YAG) sheath insulator trilayers remains to be accomplished.

Measurements of the thermal expansion of YAG indicate that the expansion mismatch with niobium (particularly from 1300 to 1500 C) may cause cracking. Limited evidence also suggests that high-temperature (1500 C and higher) reactions between YAG and niobium may also contribute to cracking. Alternative fabrication schedules need to be explored to minimize these adverse high-temperature effects. Preliminary tests indicate that alternative ceramics, such as oxide composites and aluminum oxynitride (ALON), show promise as improved sheath insulators. DOE

N89-13630# Lawrence Livermore National Lab., Calif.
PHOTOGRAPHIC DOCUMENTATION FOR AGT-86 SURVIVABILITY OF COATINGS (SOC) PROGRAM
G. Richard Wirtenson Apr. 1988 141 p
(Contract W-7405-eng-48)
(DE88-014167; UCRL-21061) Avail: NTIS HC A07/MF A01

Microphotographs are given of the 23 coating designs tested in the 1986 Aboveground Test fielded at the Blackjack 5 facility operated by Maxwell Laboratories. Details of the coating preparation methods, test results, diagnostic and computational methods can be found elsewhere. DOE

N89-13631# Idaho National Engineering Lab., Idaho Falls.
DETECTION AND CHARACTERIZATION OF POROSITY IN CERAMIC/CERAMIC COMPOSITES
J. B. Walter and L. A. Lott 25 Jul. 1988 32 p
(Contract DE-AC07-76ID-01570)
(DE88-016965; EGG-MS-8179) Avail: NTIS HC A03/MF A01

Ceramic composites are an important new type of material being developed for applications requiring high strength at high temperatures. This report focuses on composites of a SiC fabric reinforced SiC matrix formed by chemical vapor infiltration. This material is characterized by extensive porosity, which is known to limit its strength. Effective methods of nondestructively detecting and characterizing porosity in the material are needed. This is a challenging task for ultrasonics because of the high levels of porosity (greater than 10 percent) found in the material and because of the intrinsic heterogeneity and anisotropy of the material, all of which strongly affect ultrasonic propagation. Techniques are described for measuring ultrasonic attenuation, transmitted energy, and propagation velocity using through transmission. Measurements are included which show correlation with the material porosity. A mathematical model was successfully developed to help understand the measurements and to permit extrapolation of the results to other sample sets. A comparison of the model to the measurements is reported. Implications of the model on the detection and resolution of individual voids and on distinguishing them from variations in the general porosity of the material are considered. DOE

N89-13632# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
ASSESSMENT OF STRENGTH LIMITING FLAWS IN CERAMIC HEAT EXCHANGER COMPONENTS, PHASE 2 Midcontract Summary Report, 4 Dec. 1986 - 30 Nov. 1987
J. R. Bower Dec. 1987 31 p
(Contract DE-AC07-84ID-12566)
(DE88-013691; DOE/ID-12566/2) Avail: NTIS HC A03/MF A01

Advanced ceramic materials are attractive for use in environments that are too hostile for metals. Unfortunately, acceptance of ceramics in these applications has been limited because ceramics are subject to sudden failure by brittle fracture. The goal of this program is to produce acceptance criteria and appropriate verification tests for one specific component: ceramic heat exchanger tubes. The program has three major parts; NonDestructive Examination (NDE), Linear Elastic Fracture Mechanics (LEFM), and Destructive Testing (DT). Because ceramics are subject to brittle fracture, the assessment of materials for conditions that could lead to failure is vital. This is the task of NDE. Acceptance criteria must be based on a model that can predict tube lifetime, given operating conditions, material characteristics, and possible flaws present. This is the task of LEFM. NDE examination results need to be compared to failure test results, and LEFM requires test data to create and verify the fracture model. This is the task of DT. DOE

N89-13633# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ION IMPLANTATION IN CERAMICS-RESIDUAL STRESS AND PROPERTIES
C. J. McHargue, M. E. OHern, C. W. White, and M. B. Lewis 1988 25 p Presented at the International Conference on Surface Modification of Metals By Ion Beams, Riva Del Garda, Italy, 12 Sep. 1988
(Contract DE-AC05-84OR-21400)
(DE88-015555; CONF-8809115-1) Avail: NTIS HC A03/MF A01

The average and integrated stresses have been measured by the indentation technique for a series of sapphire crystals implanted with chromium or iron using a wide range of ion beam energy and fluences. The stress is compressive in nature and the average residual stress is in the range of 1100 MPa, i.e., about the value of the bulk rupture strength of defect-free single crystalline sapphire. Data for specimens implanted with iron indicate that a saturation value in average stress is reached at 10 to the 16th power Fe/square cm (160 keV) but a saturation for Cr-implantation is not apparent. The residual compressive stress has a marked influence on the apparent fracture toughness as measured by the indentation technique and the fracture strength measured in bend tests. DOE

N89-13634# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ION IRRADIATION STUDIES OF OXIDE CERAMICS
S. J. Zinkle 1988 24 p Presented at the NATO Advanced Study Institute on Structure-Property Relationships in Ion-Beam Surface-Modified Ceramics: Theory and Applications, Ciocco, Italy, 28 Aug. 1988
(Contract DE-AC05-84OR-21400)
(DE88-016784; CONF-8808108-3) Avail: NTIS HC A03/MF A01

This paper presents the initial results of an investigation of the depth-dependent microstructures of three oxide ceramics following ion implantation to moderate doses. The implantations were performed using ion species that occur as cations in the target material; for example, Mg(+) ions were used for MgO and MgAl2O3 (spinel) irradiations. This minimized chemical effects associated with the implantation and allowed a more direct evaluation to be made of the effects of implanted ions on the microstructure. DOE

N89-13635# Rochester Univ., N. Y. Lab. for Laser Energetics.
THERMOTROPIC AND OPTICAL PROPERTIES OF CHIRAL NEMATIC POLYMERS
M. L. Tsai, S. H. Chen, K. L. Marshall, and S. D. Jacobs Sep. 1988 22 p Presented at the 10th Symposium on Thermophysical Properties, Gaithersburg, Md., 20 Jun. 1988
(Contract DE-FC08-85DP-40200)
(DE88-016987; DOE/DP-40200/76; CONF-880606-6; Rept-194) Avail: NTIS HC A03/MF A01

The thermotropic and optical properties of methacrylate copolymers and chemically modified poly(gamma-benzyl L-glutamate) were investigated as part of our effort to explore the optical applications of these materials. It was found that besides the commonly cited comonomer ratio, physical blending and annealing followed by quenching represent a new and more flexible means to tune the selective reflection wavelength. In the poly (gamma-benzyl L-glutamate) systems, it appears that the relatively high melt viscosity is capable of sustaining the cholesteric mesophase, generated by annealing and quenching, up to 100 C. DOE

N89-13636# Lawrence Livermore National Lab., Calif.
LOW TEMPERATURE BONDING WITH OXIDES FOR ELECTRONIC DEVICE APPLICATIONS

Leslie A. Field and Richard S. Muller Aug. 1988 7 p
(Contract W-7405-eng-48)
(DE88-017111; UCRL-21098) Avail: NTIS HC A02/MF A01

Silicon wafers can be bonded together at temperatures as low as 450 C, using a layer of boron glass between the wafers. With further development, this discovery could be used to advantage for silicon-on-insulator work, for sensor fabrication, such as in the production of sealed cavities for pressure transducers, and for final packaging of sensors. The low temperature could make this technology especially attractive for final device packaging. The crucial step that must be developed in order to make this technology useful for device packaging is deposition of the boron glass at lower temperature conditions than those used to date. It is believed this will be a relatively straightforward task, for reasons outlined below. DOE

N89-13637# Office of Technology Assessment, Washington, D.C.
ADVANCED MATERIALS BY DESIGN
Jul. 1988 337 p
(PB88-243548; OTA-E-358; LC-87-619860) Avail: NTIS HC A15/MF A01; also available SOD HC $14.00 as 052-003-01095-0 CSCL 11C

The military and commercial opportunities presented by new structural materials technologies are analyzed and the Federal policy objectives that are consistent with those opportunities are outlined. The impact of advanced structural materials on the competitiveness of the U.S. manufacturing sector is also addressed and policy options for accelerating the commercial utilization of the materials are offered. Author

N89-13638# Sandia National Labs., Livermore, Calif. Advanced Systems Div.
GRAPHITE EPOXY TECHNOLOGY DEVELOPMENT STUDIES AT SANDIA LIVERMORE
W. J. Ghio Sep. 1988 34 p
(Contract DE-AC04-76DR-00789)
(DE89-000233; SAND-88-8243) Avail: NTIS HC A03/MF A01

To gain in-house experience in the design and fabrication of large scale hardware built from composite materials, Sandia National Laboratories initiated a program to build a suitable test component, known as Technology Development Unit Number 1. Since this was a new endeavor, different manufacturing processes were evaluated. Although steel molds could have been used for all of the lay-ups, it was decided, after talking to several graphite composite manufacturers, that graphite epoxy molds would also be used for several of the parts. This report describes in detail how these molds were constructed, shows the resultant composite parts, and also describes a part that was constructed by an outside vendor. DOE

N89-13639# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
CONTROLLED RING-OPENING METATHESIS POLYMERIZATION BY MOLYBDENUM AND TUNGSTEN ALKYLIDENE COMPLEXES Technical Report No. 2
Richard S. Schrock, Steven A. Krouse, Konrad Knoll, Jerald Feldman, and John S. Murdzek 29 Jul. 1988 32 p
(Contract N00014-87-K-0099)
(AD-A198073) Avail: NTIS HC A03/MF A01 CSCL 07F

A new, convenient preparation of tungsten (CHt-Bu)(NAr)Cl2(dme) (Ar = 2,6-diisopropylphenyl) involves treatment of W(NAr)(Ot-Bu)2(CH2t-Bu)2 with PCl5 in dimethoxyethane as a final step. From it a variety of complexes of the type W(CHt-Bu) (NAr)(or)2 (R = alkyl or fluoroalkyl) can be prepared straightforwardly in high yield. Analogous complexes of the type Mo(CHt-Bu)(NAr)(OR)2 also have been prepared. Complexes in which OR = Ot-Bu will not react with ordinary olefins, but will react with strained cyclic olefins such as norbornene and cyclopentene to give living polymers from which the organic polymer can be cleaved by treatment with aldehydes. GRA

N89-13640# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SYNTHESIS AND CHARGE TRANSPORT PROPERTIES OF POLYMERS DERIVED FROM OXIDATION OF 1-h-1 (6-PYRROL-1-yl)-HEXYL-4,4 -BIPYRIDINIUM BIS-HEXAFLUOROPHOSPHATE AND DEMONSTRATION OF A pH SENSITIVE MICROCHEMICAL TRANSISTOR DERIVED FROM THE REDOX PROPERTIES OF A CONVENTIONAL REDOX CENTER Interim Technical Report
Ching-Fong Shu and Mark S. Wrighton 15 Aug. 1988 56 p Submitted for publication
(Contract N00014-84-K-0553)
(AD-A198122; TR-22) Avail: NTIS HC A04/MF A01 CSCL 07F

This article describes the synthesis and electrochemical properties of redox polymers, having a poly-pyrrole backbone and viologen subunits, derived from oxidative electropolymerization of 1-methyl 1' (6-pyrrol-1-yl) hexyl 4,4' bipyridinium, (P-V-Me2+), and 1-H1' (6-pyrrol-1-yl) hexyl 4,4'-bipyridinium, (P-V-H2+). GRA

N89-13641# IBM Research Lab., San Jose, Calif.
CONFIGURATIONAL PROPERTIES OF A STIFF-CHAIN DIARYL SUBSTITUTED POLYSILANE IN DILUTE SOLUTION
P. M. Cotts, R. D. Miller, and R. Sooriyakumaran 1 Aug. 1988 13 p Submitted for publication
(Contract N00014-85-C-0056)
(AD-A198412; IBM-RJ6106 (60600); TR-18) Avail: NTIS HC A03/MF A01 CSCL 07F

Dilute solution properties of a diaryl substituted polysilane indicate that the chain exhibits stiffness in solution, with a persistence length on the order of 100 A. Measurements of the mean square radius of gyration, intrinsic viscosity and hydrodynamic radius at infinite dilution for a series of molecular weights were fit to theoretical expressions for the wormlike chain to estimate the persistence length. This large persistence length is consistent with the long wavelengths (395 + or - nm) electronic absorption maximum observed for the diaryl substituted silanes. Results are compared with those reported previously for diaryl substituted polysilanes. GRA

N89-13642*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL BARRIER COATINGS. ABSTRACTS AND FIGURES
1985 220 p Workshop held in Cleveland, Ohio, 21-22 May 1985
(NASA-CP-10019; E-4425; NAS 1.55:10019) Avail: NTIS HC A10/MF A01 CSCL 11C

The Thermal Barrier Coatings Workshop was held May 21 and 22, 1985, at the NASA Lewis Research Center in Cleveland, Ohio. Six sessions covered Failure Mechanisms and Life Modeling, Effects of Oxidation and Creep, Phase Stability and Microstructural Aspects, Nondestructive and Analytical Assessment, Coating Development, and Alternative Applications. For individual titles, see N89-13643 through N89-13664.

N89-13643*# Garrett Turbine Engine Co., Phoenix, Ariz.
DEVELOPMENT OF THERMOMECHANICAL LIFE PREDICTION MODELS FOR THERMAL BARRIER COATINGS
T. E. Strangman *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 1-7 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Thermal barrier coatings (TBCs) for turbine airfoils in high-performance engines represent an advanced materials technology with both performance and durability benefits. The foremost TBC benefit is the reduction of heat transferred into air-cooled components. To achieve these benefits, however, the TBC system must be reliable. Mechanistic thermomechanical and thermochemical life models and statistically significant design data are therefore required for the reliable exploitation of TBC benefits on gas turbine airfoils. Garrett's NASA-HOST Program (NAS3-23945) is designed to fulfill these requirements. This program focuses on predicting the lives of two types of

strain-tolerant and oxidation-resistant TBC systems that are produced by commercial coating suppliers to the gas turbine industry. The plasma-sprayed TBC system, composed of a low-pressure plasma-spray (LPPS) applied oxidation resistant NiCrAlY bond coating, and an air-plasma-sprayed yttria partially stabilized zirconia insulated layer is applied by both Chromalloy and Klock. The second type of TBC is applied by the electron beam-physical vapor deposition process by Temescal. Thermomechanical life models are being tailored to predict TBC strain tolerance in terms of materials, engine, and mission parameters. Continuum and fracture mechanics approaches and statistical methods are being evaluated to develop tensile and compressive strain functions required to drive a mission analysis capable thermomechanical life model for TBCs. Results of initial testing to calibrate these life models will be presented. Author

N89-13644*# Pratt and Whitney Aircraft, East Hartford, Conn.
MECHANISMS OF THERMAL BARRIER COATING DEGRADATION AND FAILURE
J. T. DeMasi and K. D. Sheffler *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 9-25 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The objectives and initial results of a Thermal Barrier Coating (TBC) Life Prediction Model Development Program are described. The goals of this program are to: identify and understand TBC failure modes; generate quantitative TBC life data; and develop and verify a TBC life prediction model. The coating being studied is a two layer thermal barrier system incorporating a nominal ten mil outer layer of seven percent yttria partially stabilized zirconia plasma deposited over an inner layer of highly oxidation resistant low pressure plasma sprayed NiCrAlY bond coating. This coating currently is in flight service on turbine vane platforms in the JT-9D and PW2037 engines and is bill-of- material on turbine vane airfoils in the advanced PW4000 and IAE V2500 engines. Effort currently is in progress on the first task, which involves the identification and understanding of TBC failures. Five modes of coating damage were considered: thermomechanical ceramic failure; oxidative bond coat failure; hot corrosion; foreign object damage (FOD); and erosion. Author

N89-13645*# Solar Turbines, Inc. San Diego, Calif.
A PERFORMANCE AND RELIABILITY MODEL FOR THERMAL BARRIER COATINGS
A. P. Batakis *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 27-32 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

A modeling technique for predicting the performance and reliability of TBC's is being developed at Solar Turbines Incorporated. The concept combines experimental coating property data with finite element analyses to predict the thermal and mechanical behavior of coating systems in service. A key feature of Solar's approach is the use of a four point flexure test to estimate coating strength distributions and to predict coating failure probability. This model was used to evaluate the effect of physical variations on coating performance in high heat flux rocket engine applications for NASA. Current work, promoted by Caterpillar Tractor Company for diesel engine applications, is being conducted to measure coating strength as a function of temperature, and future work will document strength degradation with time at temperature. Solar's interest lies in the application of TBCs to gas turbine engine components. Author

N89-13646*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF OXIDATION ON THE HIGH HEAT FLUX BEHAVIOR OF A THERMAL BARRIER COATING
Robert A. Miller *In its* Thermal Barrier Coatings. Abstracts and Figures 1985 p 33-42 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The effect of oxidation on the high heat flux behavior of a thermal barrier coating was evaluated by cyclically exposing preoxidized specimens to a 3000 C nitrogen plasma. The thermal barrier coatings consisted of a 0.025 cm layer of air-plasma-sprayed ZrO2-7 percent Y2O3 and a 0.012 cm layer of low pressure-plasma-sprayed NiCoCrAlY applied over 0.13 cm diameter B1900+Hf cylindrical substrates. A gradient of 800 C is produced across the ceramic layer in each 0.5 second exposure. This is much more severe than the gradient encountered on a gas turbine engine. Prior to exposure, the specimens were preoxidized at 1200 C for time from 0 to 20 hours. These coatings were found to be tolerant to the high heat flux plasma flame for all but the most severe preoxidations. However, life degraded rapidly for preoxidation times in excess of 15 hours at 1200 C. A log-log plot of cycles-to-failure vs estimated oxidative weight gain yield a straight or nearly straight line, and this line could be rationalized using an oxidation-based model that was developed previously for low heat flux applications. Author

N89-13647*# General Electric Co., Cincinnati, Ohio.
EFFECT OF BOND COAT CREEP AND OXIDATION ON TBC INTEGRITY
E. C. Duderstadt and B. H. Pilsner *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 43-52 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The potential of thermal barrier coatings (TBCs) on high-pressure turbine (HPT) nozzles and blades is limited at present by the inability to quantitatively predict TBC life for these components. The goal is to isolate the major TBC failure mechanisms, which is part of the larger program aimed at developing TBC life prediction models. Based on the results of experiments to isolate TBC failure mechanisms, the effects of bond coat oxidation and bond coat creep on TBC integrity is discussed. In bond coat oxidation experiments, Rene prime 80 specimens coated with a NiCrAlY/ZrO2-8 percent Y2O3 TBC received isothermal pre-exposures at 2000 F in static argon, static air, or received no pre-exposure. The effects of oxidation due to the pre-exposures were determined by thermal cycle tests in both static air and static argon at 2000 F. To study the effect of bond coat creep on TBS behavior, four bond coats with different creep properties were evaluated by thermal cycle tests in air at 2000 F. The test results, the relative importance of these two failure mechanisms, and how their effects may be quantified will also be discussed. Author

N89-13648*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN INVESTIGATION OF ENVIRONMENTAL INFLUENCE ON THE CREEP BEHAVIOR OF A LOW PRESSURE PLASMA SPRAYED NiCoCrAlY ALLOY
M. G. Hebsur and R. V. Miner *In its* Thermal Barrier Coatings. Abstracts and Figures 1985 p 53-58 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Low pressure sprayed MCrAlY overlay coatings are currently being used on advanced single crystal superalloy blades for gas turbine engines. Many studies were made on the influence of coatings on the mechanical properties of superalloys in oxidizing or hot-corroding environments, but very few on the properties of the bulk coating alloy itself. The creep behavior of a typical NiCoCrAlY alloyd (PWA 276) was studied in air and vacuum. The as-received low pressure plasma sprayed NiCoCrAlY plates were heat treated for 4 h at 1080 C followed by 32 h at 870 C, the heat treatment applied to coated superalloy parts. Standard creep specimens 12.7 mm long and 3.2 mm in diameter were then machined. Constant load creep-rupture tests were performed in air and vacuum at 650, 850, and 1050 C and various initial stresses. In addition, some specimens were preoxidized at 1050 C for 100 h prior to testing. Results are briefly discussed. Author

N89-13649*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy and Materials Science.
MICROSTRUCTURAL ASPECTS OF ZIRCONIA THERMAL BARRIER COATINGS
T. E. Mitchell, D. S. Suhr, R. J. Keller, V. Lanteri, and A. H. Heuer *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 59-76 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Various combination of plasma-sprayed bond coatings and zirconia ceramic coatings on a nickel-based superalloy substrate were tested by static thermal exposure at 1200 C and cyclic thermal exposure to 1000 C. The bond coats were based on Ni-Cr-Al alloys with additions of rare earth elements and Si. The ceramic coats were various ZrO2-Y2O3 compositions, of which the optimum was found to be ZrO2-8.9 wt percent Y2O3. Microstructural analysis showed that resistance to cracking during thermal exposure is strongly related to deleterious phase changes. Zones depleted of Al formed at the bond coat/ceramic coat interface due to oxidation and at the bond coat/substrate interface due to interdiffusion, leading eventually to breakdown of the bond coat. The 8.9 percent Y2O3 coating performed best because the as-sprayed metastable tetragonal phase converted slowly into the low-Y2O3 tetragonal plus high-Y2O3 cubic-phase mixture, so that the deleterious monoclinic phase was inhibited from forming. Failure appeared to start with the formation of circumferential cracks in the zirconia, probably due to compressive stresses during cooling, followed by the formation of radial cracks due to tensile stresses during heating. Cracks appeared to initiate at the Al2O3 scale/bond coat interface and propagate through the zirconia coating. Comparisons were made with the behavior of bulk ZrO2-Y2O3 and the relationship between the microstructure of the tetragonal phase and the phase diagram. A separate investigation was also made of the ZrO2-Al2O3 interface. Author

N89-13650*# Worcester Polytechnic Inst., Mass.
THE ROLE OF MICROSTRUCTURE AND PHASE DISTRIBUTION IN THE FAILURE MECHANISMS AND LIFE PREDICTION MODEL FOR PSZ COATINGS
R. D. Sisson, Jr., Ichiro Sone, and R. R. Biederman *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 77-84 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Partially Stabilized Zirconia (PSZ) may become widely used for Thermal Barrier Coatings (TBC). Failure of these coatings can occur due to thermal fatigue in oxidizing atmospheres. The failure is due to the strains that develop due to thermal gradients, differences in thermal expansion coefficients, and oxidation of the bond coating. The role of microstructure and the cubic, tetragonal, and monoclinic phase distribution in the strain development and subsequent failure will be discussed. An X-ray diffraction technique for accurate determination of the fraction of each phase in PSZ will be applied to understanding the phase transformations and strain development. These results will be discussed in terms of developing a model for life prediction in PSZ coatings during thermal cycling. Author

N89-13651*# Naval Research Lab., Washington, D.C.
CERAMIC OXIDE REACTIONS WITH V2O5 AND SO3
R. L. Jones and C. E. Williams *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 85-93 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Ceramic oxides are not inert in combustion environments, but can react with, inter alia, SO3, and Na2SO4 to yield low melting mixed sulfate eutectics, and with vanadium compounds to produce vanadates. Assuming ceramic degradation to become severe only when molten phases are generated in the surface salt (as found for metallic hot corrosion), the reactivity of ceramic oxides can be quantified by determining the SO3 partial pressure necessary for molten mixed sulfate formation with Na2SO3. Vanadium pentoxide is an acidic oxide that reacts with Na2O, SO3, and the different ceramic oxides in a series of Lux-Flood type of acid-base displacement reactions. To elucidate the various possible vanadium compound-ceramic oxide interactions, a study was made of the reactions of a matrix involving, on the one axis, ceramix oxides of increasing acidity, and on the other axis, vanadium compounds of increasing acidity. Resistance to vanadium compound reaction increased as the oxide acidity increased. Oxides more acidic than ZrO2 displaced V2O5. Examination of Y2O3- and CeO2-stabilized ZrO2 sintered ceramics which were degraded in 700 C NaVO3 has shown good agreement with the reactions predicted above, except that the CeO2-ZrO2 ceramic appears to be inexplicably degraded by NaVO3. Author

N89-13652*# Sandia National Labs., Livermore, Calif. Combustion Research Facility.
DESTABILIZATION OF YTTRIA-STABILIZED ZIRCONIA INDUCED BY MOLTEN SODIUM VANADATE-SODIUM SULFATE MELTS
A. S. Nagelberg and J. C. Hamilton *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 95-109 Sponsored by DOE (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The extent of surface destabilization of ZrO2 - 8 wt percent Y2O3 ceramic disks was determined after exposure to molten salt mixtures of sodium sulfate containing up to 15 mole percent sodium metavanadate (NaVO3) at 1173 K. The ceramic surface was observed to transform from the cubic/tetragonal to monoclinic phase, concurrent with chemical changes in the molten salt layer in contact with the ceramic. Significant attack rates were observed in both pure sulfate and metavanadate sulfate melts. The rate of attack was found to be quite sensitive to the mole fraction of vanadate in the molten salt solution and the partial pressure of sulfur trioxide in equilibrium with the salt melt. The observed parabolic rate of attack is interpreted to be caused by a reaction controlled by diffusion in the salt that penetrates into the porous layer formed by the destabilization. The parabolic rate constant in mixed sodium metavanadate - sodium sulfate melts was found to be proportional to the SO3 partial pressure and the square of the metavanadate concentration. In-situ Raman spectroscopic measurements allowed simultaneous observations of the ceramic phases and salt chemistry during the attack process. Author

N89-13653*# Cleveland State Univ., Ohio.
FINITE ELEMENT ANALYSIS OF THERMAL BARRIER COATINGS
G. C. Chang and W. Phucharoen *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 111-126 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The near-term objective is to develop an understanding of the states of stresses and strains in a Zirconia-yttria thermal barrier coating (TBC) experiencing a given temperature drop. Results so obtained are expected to facilitate experimental work. In order to gain realistic insights into the distribution of stresses and strains in a complex TBC, the finite element approach was selected to model a cylindrical TBC specimen. Experimental evidence reported in the literature indicated the presence of rough interface between the ceramic coat and bond coat. Oxidation of the bond coat at ceramic-bond interface was observed, as was a small amount of cracking in the ceramics near the ceramic-bond interface. To account for these complex features, a plane-strain finite element computer program known as TBCOC was developed, taking advantage of a generic computer code known as MARC. This generic code was made available through the use of a supercomputer (Cray 1). The TBCOC model contains 1316 nodal points and 2140 finite elements. It is capable of a uniform isothermal loading. Results of a sample computer run are presented.
Author

N89-13654*# Cleveland State Univ., Ohio.
EXAMINATION OF COATING FAILURE BY ACOUSTIC EMISSION

Christopher C. Berndt *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 127-137 (For primary document see N89-13642 05-27)
(Contract NCC3-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Coatings of NiCrAlY bond coat with a zirconia - 12 wt percent yttria overlay were applied to disc-shaped specimens of U-700 alloy. A waveguide of 1 mm diameter platinum was TIG welded to the specimen and allowed it to be suspended in a tubular furnace. The specimen was thermally cycled to 1150 C, and the acoustic emission (AE) monitored. The weight gain per thermal cycle was also measured. A computer system based on the IBM-XT microcomputer was used extensively to acquire the AE data with respect to temperature. This system also controlled the temperature by using a PD software loop. Several different types of AE analyses were performed. A major feature of these tests, not addressed by previous work in this area, was that the coatings covered 100 percent of the specimen and also that the AE was amplified at two different levels. It is believed that this latter feature allows a qualitative appraisal of the relative number of cracks per AE event. The difference in AE counts between the two channels is proportional to the number of cracks per AE event, and this parameter may be thought of as the crack density. The ratio of the AE count difference to the AE count magnitude of one channel is inversely proportional to the crack growth. Both of these parameters allow the crack distribution and crack growth within each specimen to be qualitatively followed during the thermal cycling operation. Recent results which used these principles will be presented. Author

N89-13655*# Westinghouse Hanford Co., Richland, Wash.
DETERMINING BONDING, THICKNESS, AND DENSITY VIA THERMAL WAVE IMPEDANCE NDE
D. R. Green *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 139-153 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Bonding, density, and thickness of coatings have a vital effect on their performance in many applications. Pioneering development work on thermal wave nondestructive evaluation (NDE) methods during the past 25 years has resulted in an array of useful techniques for performing bonding, density, and thickness measurements in a practical shop environment. The most useful thermal wave methods for this purpose are based on thermal wave surface impedance measurement or scanning. A pulse of heat from either a thermal transducer or a hot gas pulse is projected onto the surface, and the resulting temperature response is analyzed to unfold the bonding, density, and thickness of the coating. An advanced emissivity independent infrared method was applied to detect the temperature response. These methods were recently completely computerized and can automatically provide information on coating quality in near real-time using the proper equipment. Complex shapes such as turbine blades can be scanned. Microscopic inhomogeneities such as microstructural differences and small, normal, isolated voids do not cause problems but are seen as slight differences in the bulk thermal properties. Test objects with rough surfaces can be effectively nondestructively evaluated using proper thermal surface impedance methods. Some of the basic principles involved, as well as metallographic results illustrating the ability of the thermal wave surface impedance method to detect natural nonbonds under a two-layer thermally sprayed coating, will be presented. Author

N89-13656*# General Electric Co., Evendale, Ohio. Aircraft Engine Business Group.
CHARACTERIZATION OF ZrO2-Y2O3 THERMAL SPRAY POWDER SYSTEMS
Thomas E. Mantkowski, David V. Rigney, Marc J. Froning, and N. Jayaraman (Cincinnati Univ., Ohio.) *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 155-165 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The overall objective is to establish the interrelation between the raw material in the coating process and the performance of the coating deposit. It is anticipated that these interrelations will help establish more precise specifications for the procurement of the raw materials. Some of the preliminary results of the program are presented. Author

N89-13657*# National Bureau of Standards, Gaithersburg, Md.
ALUMINUM OXIDE BARRIERS IN MCrAlY SUPERALLOY SYSTEMS
Kenneth G. Kreider *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 167-170 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

An investigation was made of sputtered aluminum oxide diffusion barriers to protect gas turbine engine blade and vane alloys from their coatings. MAR M200 + Hf coated with sputtered NiCoCrAlY and MAR M509 coated with sputtered FeCrAlY were obtained both with and without 1 and 2 micron sputtered Al2O3 barrier layers. Electron dispersive X-ray analysis was used to determine the concentration profiles of as-received and heat treated samples. Author

N89-13658*# Metco, Inc., Westbury, N. Y. Materials Engineering and R/D Development.
ADVANCED THERMAL BARRIER COATING SYSTEMS
M. R. Dorfman and J. D. Reardon *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 171-178 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Current state-of-the-art thermal barrier coating (TBC) systems consist of partially stabilized zirconia coatings plasma sprayed over a MCrAlY bond coat. Although these systems have excellent thermal shock properties, they have shown themselves to be deficient for a number of diesel and aircraft applications. Two ternary ceramic plasma coatings are discussed with respect to their possible use in TBC systems. Zirconia-ceria-yttria (ZCY) coatings were developed with low thermal conductivities, good thermal shock resistance and improved resistance to vanadium containing environments, when compared to the baseline yttria stabilized zirconia (YSZ) coatings. In addition, dense zirconia-titania-yttria (ZTY) coatings were developed with particle erosion resistance exceeding conventional stabilized zirconia coatings. Both coatings were evaluated in conjunction with a NiCr-Al-Co-Y2O3 bond coat. Also, multilayer or hybrid coatings consisting of the bond coat with subsequent coatings of zirconia-ceria-yttria and zirconia-titania-yttria were evaluated. These coatings combine the enhanced performance characteristics of ZCY with the improved erosion resistance of ZTY coatings. Improvement in the erosion resistance of the TBC system should result in a more consistent delta T gradient during service. Economically, this may also translate into increased component life simply because the coating lasts longer. Author

N89-13659*# California Univ., Los Angeles. Dept. of Materials Science and Engineering.
MICROLAMINATE COMPOSITES: AN ALTERNATE APPROACH TO THERMAL BARRIER COATINGS
R. F. Bunshah, C. V. Deshpandey, and B. P. OBrien *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 179-186 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Ceramic thermal barrier coatings suffer from a major drawback, i.e., brittle behavior. An alternate approach is microlaminate composite coatings consisting of alternate layers of metal and oxide. As the thickness of the individual laminae decrease while keeping the total thickness of the coating constant, the thermal conductivity drops markedly. Data on the Fe-Cu system will be presented. A model is proposed for an MCrAlY-Al2O3 microlaminate coating for thermal barriers. The methods of fabrication will also be discussed. Author

N89-13660*# Rolls-Royce, Inc., Atlanta, Ga.
HIGH TIME SERVICE EVALUATION OF THERMAL BARRIER COATINGS ON THE ROLLS-ROYCE RB211 ENGINE
F. Chris Toriz *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 187-196 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

One of the main concerns of airline operators for the use of thermal barrier coatings (TBC) in the turbine is that the coating will spall and cause a premature engine removal. Even though much cyclic data is available on TBCs, high time data is much harder and expensive to come by. The typical 150 h type test used to qualify hardware, or modifications, falls far short of the 5 to 10,000 hour experience desired. One way to obtain data demonstrating the longevity of TBCs is through a service evaluation program on a commercial engine. For a meaningful evaluation of the TBC system it must be applied to a component which operates in a typical hot end environment. In addition the component performance should not suffer if the coating is lost. For these reasons Rolls-Royce chose to coat the IP turbine nozzle guide vanes, and run these in an RB211 engine. Two ceramic top coats and several different bond coats were tested in a rainbow fashion on several engines. Three layer magnesium zirconate was used as a base line. Various yttria stabilized zirconia ceramics were used. Top MCrAlY bond coats were applied by various techniques. Some of the coated vanes have now accumulated ofer 5000 hours. The results are presented from the first sets with 2500 and 4200 hours of service respectively. Author

N89-13661*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL BARRIER COATINGS FOR THE SPACE SHUTTLE MAIN ENGINE TURBINE BLADES
B. N. Bhat, H. L. Gilmore, and R. R. Holmes *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 197-202 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The Space Shuttle Main Engine (SSME) turbopump turbine blades experience extremely severe thermal shocks during start-up and shut-down. For instance, the high pressure fuel turbopump turbine which burns liquid hydrogen operates at approximately 1500 F, but is shut down fuel rich with turbine blades quenced in liquid hydrogen. This thermal shock is a major contributor to blade cracking. The same thermal shock cause the protective ZrO2 thermal barrier coatings to spall or flake off, leaving only the NiCrAlY bond coating which provides only a minimum thermal protection. The turbine blades are therefore life limited to about 3000 sec for want of a good thermal barrier. A suitable thermal barrier coating (TBC) is being developed for the SSME turbine blades. Various TBCs developed for the gas turbine engines were tested in a specially built turbine blade tester. This tester subjects the coated blades to thermal and pressure cycles similar to those during actual operation of the turbine. The coatings were applied using a plasma spraying techniques both under atmospheric conditions and in vacuum. Results are presented. In general vacuum plasma sprayed coatings performed much better than those sprayed under atmospheric conditions. A 50 to 50 blend of Cr2O3 and NiCrAlY, vacuum plasma sprayed on SSME turbopump turbine blades appear to provide significant improvements in coating durability and thermal protection. Author

N89-13662*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CYCLIC STRESS ANALYSIS OF CERAMIC COATED GAS TURBINE SEALS
Joe Padovan, Dan Dougherty (General Tire and Rubber Co., Akron, Ohio.), and Bob Hendricks *In its* Thermal Barrier Coatings. Abstracts and Figures 1985 p 203-209 (For primary document see N89-13642 05-27)
(Grant NAG3-265)
Avail: NTIS HC A10/MF A01 CSCL 11C

Through the use of the Finite Element Method, the cyclic thermomechanical response of ceramic coated gas turbine parts is considered. The analysis includes temperature dependent elastic-plastic-creep material properties and cyclic thermal loads. To demonstrate the cyclic thermomechanical response, a ceramic coated outer gas path seal is studied. The analysis will estimate the significant residual stress field created by the cyclic thermal loads. Author

N89-13663*# Avco Lycoming Div., Stratford, Conn.
FABRICATION OF STRAIN-ISOLATED CERAMIC COATED COMBUSTOR COMPONENTS
S. Rutter *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 211-217 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

The use of strain-isolated ceramic coated material to produce an AGT1500 combustor scroll-shaped transition duct which requires no air for film cooling is investigated. The scroll receives the exhaust of the can-style combustor liner and turns it into the annular inlet of the high pressure gas producer turbine nozzle. Strain-isolation of plasma sprayed thermal barrier coating is achieved by placing a compliant pad between the structural base metal and the ceramic coating. The compliant pad is brazed to the metal structure. In order to achieve a good braze bond, the strain-isolating compliant pad and base metal must be closely matched in shape and tightly fixtured for joining. The complex geometry of the AGT1500 scroll makes it impractical to attack pads to the supporting structure in its finished shape. Instead the pads are brazed to flat stock and post-formed into scroll sections. While test samples were successfully post-formed, plasma sprayed, and subjected to cyclic heating, the forming of full scale parts by normal methods resulted in tearing of the Hastelloy-X base metal because of embrittlement by the braze material. Several solutions were explored which finally resulted in the successful forming of full scale scroll parts.
Author

N89-13664*# Brunswick Technetics, Deland, Fla.
STRAIN ISOLATED CERAMIC COATINGS
R. P. Tolokan, J. B. Brady, and G. P. Jarrabet *In* NASA, Lewis Research Center, Thermal Barrier Coatings. Abstracts and Figures 1985 p 219-225 (For primary document see N89-13642 05-27)
Avail: NTIS HC A10/MF A01 CSCL 11C

Plasma sprayed ceramic coatings are used in gas turbine engines to improve component temperature capability and cooling air efficiency. A compliant metal fiber strain isolator between a plasma sprayed ceramic coating and a metal substrate improves ceramic durability while allowing thicker coatings for better insulation. Development of strain isolated coatings has concentrated on design and fabrication of coatings and coating evaluation via thermal shock testing. In thermal shock testing, five types of failure are possible: buckling failure im compression on heat up, bimetal type failure, isothermal expansion mismatch failure, mudflat cracking during cool down, and long term fatigue. A primary failure mode for thermally cycled coatings is designated bimetal type failure. Bimetal failure is tensile failure in the ceramic near the ceramic-metal interface. One of the significant benefits of the strain isolator is an insulating layer protecting the metal substrate from heat deformation and thereby preventing bimetal type failure. Author

N89-13665# Northwestern Univ., Evanston, Ill. Dept. of Physics.
NMR INVESTIGATION OF POROUS STRUCTURES, CERAMICS AND SANDSTONES Annual Technical Progress Report
W. P. Halperin Jan. 1988 11 p
(Contract DE-FG02-86ER-45251)
(DE88-006405; DOE/ER-45251/T1) Avail: NTIS HC A03/MF A01

In the past year we have continued our investigation of the fundamental aspects of NMR relaxation analysis of porous bodies and have opened two new directions. The first of these results from a strong collaborative arrangement established with

BP/America. Here it has been possible to gain access to carefully controlled SiC powders and SiC green bodies for NMR relaxation characterization of their pore space. This work includes the first imaging results on a SiC rotor green body. Secondly, we have started a small processing program to prepare magnetic field aligned high T sub c superconducting ceramics. Such c-axis aligned materials offer the potential for improved physical characterization since the principal anisotropy in physical measurement on superconducting compacts is associated with the c-axis. More important is the need to prepare the bulk semiconducting materials with larger critical current densities. This might also be achievable using magnetic fields induced alignment with binderless compaction method that we are developing. Author

N89-13666*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-STRENGTH SILICON CARBIDES BY HOT ISOSTATIC PRESSING
Sunil Dutta 1988 19 p Presented at the 3rd International Symposium on Ceramic Materials and Components for Engines, Las Vegas, Nev., 27-30 Nov. 1988; sponsored by the American Ceramic Society
(NASA-TM-101400; E-4484; NAS 1.15:101400) Avail: NTIS HC A03/MF A01 CSCL 11C

Silicon carbide has strong potential for heat engine hardware and other high-temperature applications because of its low density, good strength, high oxidation resistance, and good high-temperature creep resistance. Hot isostatic pressing (HIP) was used for producing alpha and beta silicon carbide (SiC) bodies with near-theoretical density, ultrafine grain size, and high strength at processing temperatures of 1900 to 2000 C. The HIPed materials exhibited ultrafine grain size. Furthermore, no phase transformation from beta to alpha was observed in HIPed beta-SiC. Both materials exhibited very high average flexural strength. It was also shown that alpha-SiC bodies without any sintering aids, when HIPed to high final density, can exhibit very high strength. Fracture toughness K (sub C) values were determined to be 3.6 to 4.0 MPa m (sup 1/2) for HIPed alpha-SiC and 3.7 to 4.1 MPa m (sup 1/2) for HIPed beta-SiC. In the HIPed specimens strength-controlling flaws were typically surface related. In spite of improvements in material properties such as strength and fracture toughness by elimination of the larger strength-limiting flaws and by grain size refinement, HIPing has no effect on the Weibull modulus. Author

N89-14159*# University of Central Florida, Orlando. Dept. of Chemistry.
THE SYNTHESIS OF CONDUCTING POLYMERS FOR CORROSION PREVENTION
Guy C. Mattson *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 118-129 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 11C

N89-14165*# South Carolina Univ., Columbia. Dept. of Physics.
ELECTROSTATIC TESTING OF THIN PLASTIC MATERIALS
S. Ballou Skinner *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 384-411 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N89-13667# SRI International Corp., Menlo Park, Calif.
GUM AND DEPOSIT FORMATION IN DIESEL FUELS Final Report, 1984 - 1988
Frank R. Mayo and Theodore Mill 15 May 1988 101 p
(Contract DAAG29-84-K-0161)
(AD-A197169; SRI-PYU-7753; ARO-21165.7-EG) Avail: NTIS HC A06/MF A01 CSCL 21D

We examined two aspects of the stability of diesel fuels in storage: the formation of sediments in suspension, which subsequently clog filters, and the formation of soluble gum, which passes the filters but then forms hard deposits on hot engine parts. Research on fuel stability at SRI during the last 6 years has shown that soluble gum appears first on storage, and then part of it grows into sediment. If the oxidation mixture is agitated gently, the precipitating gum grows on the surface gum, and no loose sediment is formed. We distinguished three mechanisms of gum formation: (1) a process intimately associated with chain propagation and termination during oxidation, (2) a coupling of fuel molecules by decomposing peroxides in the absence of oxygen, and (3) a condensation of naphthols and aldehydes from the oxidation of alkylnaphthalenes. The polymeric oxidation products from a JP-8 fuel are shown to be largely responsible for deposits in the Jet Fuel Thermal Oxidation Tester (JFTOT). GRA

N89-13668# Naval Weapons Center, China Lake, Calif.
DIAZOPHENOLS: THEIR STRUCTURE AND EXPLOSIVE PROPERTIES Final Report, Apr. 1985 - Apr. 1987
Charlotte K. Lowe-Ma, Robin A. Nissar, and William S. Wilson Aug. 1987 30 p
(AD-A197439; AD-E900740; NWC-TP-6810) Avail: NTIS HC A03/MF A01 CSCL 19A

The bonding structure of diazophenols has been examined by X-ray crystal structure determination and by 13C nuclear magnetic resonance (NMR) spectroscopy. GRA

N89-13669# Naval Weapons Center, China Lake, Calif.
X-RAY CRYSTAL STRUCTURES OF FOUR ENERGETIC ISOMERIC CYCLIC NITRAMINES Interim Report, 1 Jan. 1983 - 31 Mar. 1985
Charlotte K. Lowe-Ma and Rodney L. Willer Oct. 1987 168 p
(AD-A197440; AD-E900760; NWC-TP-6681) Avail: NTIS HC A08/MF A01 CSCL 20B

The Navy has a need for new energetic compounds that are dense and energetic but that also have high thermal and chemical stability and low sensitivity to impact. GRA

N89-13670# Lawrence Livermore National Lab., Calif. Chemistry and Materials Science Dept.
DYNAMIC MECHANICAL AND THERMAL ANALYSIS OF CRYSTALLINITY DEVELOPMENT IN Kel-F 800 AND TATB/Kel-F 800 PLASTIC BONDED EXPLOSIVES. PART 1: Kel-F 800
D. Mark Hoffman, Florida M. Matthews, and Cesar O. Pruneda Jun. 1988 11 p Presented at the 17th North American Thermal Analysis Society (NATAS) Conference, Orlando, Fla., 9 Oct. 1988 and JOWOG 28, Albuquerque, N. Mex., 10-12 Oct. 1988
(Contract W-7405-eng-48)
(DE88-014154; UCRL-98560-Pt-1; CONF-8810123-1-Pt-1) Avail: NTIS HC A03/MF A01

Dynamic mechanical and differential scanning calorimeter measurements were made on Kel-F 800, a copolymer of chlorotrifluoroethylene and vinylidene fluoride, as a function of time. Samples annealed over a 30-day period at 50 C showed reduced relaxation strength in the glass-transition which directly correlated with the development of between 10 percent and 15 percent

crystallinity in this polymer. Kel-F 800 samples were thermally cycled from -54 to 74 C without annealing for 12, 24, and 36 cycles developed only about half the crystallinity of annealed samples. Kel-F 800 which was annealed 30 days and subsequently subjected to the above thermal cycling retained almost all of the crystallinity which developed during the annealing process. These results indicate that Kel-F 800 copolymer crystallizes at an extremely slow rate, but as long as the thermal excursion remains below the major melting peak most of the crystallinity remains.
DOE

N89-14158*# Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.
STUDIES OF CRYOGENIC PROPELLANT STORAGE AND HANDLING FOR THE LUNAR LANDING AND LAUNCH FACILITY (COMPLEX 39L)
Jerald N. Linsley *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 78-117 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 21I

N89-14162*# Florida Inst. of Tech., Melbourne. Dept. of Aerospace and Mechanical Engineering.
ON THE HAZARD OF HYDROGEN EXPLOSIONS AT SPACE SHUTTLE LAUNCH PADS
John M. Russell *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 207-250 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 21I

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

N89-13671*# Massachusetts Inst. of Tech., Cambridge. Materials Processing Center.
THE MATERIALS PROCESSING RESEARCH BASE OF THE MATERIALS PROCESSING CENTER Annual Report, year ending 30 Sep. 1986
R. M. Latanision 30 Sep. 1986 61 p
(Grant NAGw-7645)
(NASA-CR-183016; NAS 1.26:183016) Avail: NTIS HC A04/MF A01 CSCL 22A

An annual report of the research activities of the Materials Processing Center of the Massachusetts Institute of Technology is given. Research on dielectrophoresis in the microgravity environment, phase separation kinetics in immiscible liquids, transport properties of droplet clusters in gravity-free fields, probes and monitors for the study of solidification of molten semiconductors, fluid mechanics and mass transfer in melt crystal growth, and heat flow control and segregation in directional solidification are discussed. For individual titles, see N89-13672 through N89-13677.

N89-13672*# Massachusetts Inst. of Tech., Cambridge.
DIELECTROPHORESIS IN THE MICROGRAVITY ENVIRONMENT
R. M. Rose *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 5-8 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 22A

Microgravity and vacuum, singly or combined, are uniquely advantageous media for the use of dielectrophoresis as a mmaterial s separation technology. In order to assess these advantages, a free-fall vacuum dielectrophoretic separator was designed and constructed for use at the earth's surface. Author

N89-13673*# Massachusetts Inst. of Tech., Cambridge.
PHASE SEPARATION KINETICS IN IMMISCIBLE LIQUIDS **c25**
D. R. Sadoway *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 9-11 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 07D

The kinetics of phase separation in the succinonitrile-water system are being investigated. Experiments involve initial physical mixing of the two immiscible liquids at a temperature above the consolute, decreasing the temperature into the miscibility gap, followed by imaging of the resultant microstructure as it evolves with time. Refractive index differences allow documentation of the changing microstructures by noninvasive optical techniques without the need to quench the liquid structures for analysis. Author

N89-13674*# Massachusetts Inst. of Tech., Cambridge.
TRANSPORT PROPERTIES OF DROPLET CLUSTERS IN GRAVITY-FREE FIELDS
Howard Brenner *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 13-18 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 22A

Clusters of liquid droplets are suspended in an atmosphere of saturated vapor and are subjected to an external force field. This system can be modeled as a continuum whose macroscopic properties may be determined by applying the generalized theory of Taylor dispersion. Author

N89-13675*# Massachusetts Inst. of Tech., Cambridge.
PROBES AND MONITORS FOR THE STUDY OF SOLIDIFICATION OF MOLTEN SEMICONDUCTORS **c76**
D. R. Sadoway *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 19-25 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 20L

The purpose is to examine solidification in the LiCl-KCl system to determine if phenomena such as solute rejection can be obseved by laser schlieren imaging. Molten salts have attributes that make them attractive as physical models in solidification studies. With optical techniques of investigation such as schlieren imaging, it is possible to study fluid flow phenomena in molten salts and to watch the trajectory of the solid-liquid interface. Author

N89-13676*# Massachusetts Inst. of Tech., Cambridge.
FLUID MECHANICS AND MASS TRANSFER IN MELT CRYSTAL GROWTH: ANALYSIS OF THE FLOATING ZONE AND VERTICAL BRIDGMAN PROCESSES **c76**
R. A. Brown *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 27-48 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 20L

This research program focuses on analysis of the transport mechanisms in solidification processes, especially one of interest to the Microgravity Sciences and Applications Program of NASA. Research during the last year has focused on analysis of the dynamics of the floating zone process for growth of small-scale crystals, on studies of the effect of applied magnetic fields on convection and solute segregation in directional solidification, and on the dynamics of microscopic cell formation in two-dimensional solidification of binary alloys. Significant findings are given.
Author

N89-13677*# Massachusetts Inst. of Tech., Cambridge.
HEAT FLOW CONTROL AND SEGREGATION IN DIRECTIONAL SOLIDIFICATION: DEVELOPMENT OF AN EXPERIMENTAL AND THEORETICAL BASIS FOR BRIDGMAN-TYPE GROWTH EXPERIMENTS IN A MICROGRAVITY ENVIRONMENT
A. F. Witt *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 49-61 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 22A

Within the framework of the proposed research, emphasis was placed on application of magnetic fields to semiconductor growth systems. It was found that magnetic fields up to 3 kGauss do not affect the growth behavior nor the macro-segregation behavior in the system Ge(Ga). Applied fields are found to significantlty alter the radial dopant distribution, which is attributed to alterations in the spatial orientation of convective cells. Increasing the magnetic field to 30 kGauss is found to have a fundamental effect on dopant segregation. Emphasis is also placed on the potential of KC-135 flights for preliminary studies on the effects of reduced gravity environments on the wetting behavior of semiconductor systems in growth configuration. The limited number of experiments conducted does not allow any conclusions on the merits of KC-135 flights for semiconductor processing research. Author

N89-13678# Pacific Northwest Labs., Richland, Wash.
REDUCED GRAVITY BOILING AND CONDENSING EXPERIMENTS SIMULATED WITH THE COBRA/TRAC COMPUTER CODE
J. M. Cuta and W. J. Krotiuk Feb. 1988 27 p Presented at the 1st AIAA, ASME, SIAM and APS National Fluid Dynamics Congress, Cincinnati, Ohio, 24 Jul. 1988
(Contract DE-AC06-76RL-01830)
(DE88-016311; PNL-SA-15368; CONF-880716-8) Avail: NTIS HC A03/MF A01

It is being recognized that there does not currently exist an adequate understanding of flow and heat transfer behavior in reduced- and zero-gravity. There is not a sufficient experimental fluid-thermal data base to develop design correlations for two-phase pressure losses, heat transfer coefficients, and critical heat flux limits in systems proposed for advanced power sources, propulsion, and other thermal management systems in space. Pacific Northwest Laboratory (PNL), is the lead laboratory for thermal hydraulics in the Department of Energy's Multimegawatt Space Power Program, and has the responsibility of developing microgravity thermal-hydraulic analysis capabilities for application to space nuclear power systems. In support of this program, PNL has performed a series of reduced-gravity two-phase flow experiments in the NASA KC-135 aircraft. The objective of the experiment was to supply basic thermal-hydraulic information that could be used in development of analytical design tools. DOE

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N89-14166*# North Carolina Univ., Charlotte. Dept. of Engineering Technology.
LABORATORY TESTING OF A SUPERCRITICAL HELIUM PUMP FOR A MAGNETIC REFRIGERATOR
Pao-lien Wang *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 412-439 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 13B

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N89-13679# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EUCLIDEAN MEASURE FOR THE ELECTROMAGNETIC FIELD
J. Loeffelholz 1987 16 p In RUSSIAN; ENGLISH summary (DE88-702926; JINR-R-2-87-386) Avail: NTIS (US Sales Only) HC A03/MF A01

A rigorous Euclidean approach to the quantization of the electromagnetic field F(sub ij) (x), where x = (t,x*) is an element of R sup 4, is presented. The field is considered as a family of coordinates on some probability space (omega, sigma, mu). Our main result is the construction of an isomorphism sigma/I approximately equals omega times the union of Q and B(sup 0), where the ideal I corresponds to Faraday's law and Q,B(sup 0) are sigma-subalgebras. In particular, the restriction mu/vector-B(sup 0) appears to be part space measure for a Markov process -- t is an element of R, as R approaches B(sub ij) (t,x*). Using a Feynman-Katz formula the photon propagator is derived. DOE

N89-13680# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
ELECTROMAGNETIC FIELDS RADIATED FROM ELECTROSTATIC DISCHARGES: THEORY AND EXPERIMENT
Perry F. Wilson, Arthur R. Ondrejka, Mark T. Ma, and John M. Ladbury Feb. 1988 73 p
(PB88-211149; NBS/TN-1314) Avail: NTIS HC A04/MF A01; also available SOD HC $3.50 as 003-003-02864-9 CSCL 20N

The fields radiated by electrostatic discharges (ESD) are studied both theoretically and experimentally. The ESD spark is modeled theoretically as an electrically short, time dependent, linear dipole situated above an infinite ground plane. Experimentally, sparks of varying voltages are generated by a commercially available simulator and used to excite a number of targets including: (1) the extended inner conductor of a coaxial cable mounted in a ground plane, (2) direct discharges to a ground plane, (3) indirect radiation from a large metal plate, (4) a metal chair over a a ground plane, and (5) a metal trash can. Results show that relatively low-voltage sparks (2 to 4 kV) excite the strongest radiated fields. This suggests that the spark fields can pose a significant interference threat to electronic equipment into the gigahertz range. GRA

N89-13681 New South Wales Univ., Kensington (Australia). School of Surveying.
DATA UPDATE IN A LAND INFORMATION NETWORK M.S. Thesis
Robin C. Mullin Jan. 1988 2 p
Avail: Issuing Activity

The on-going update of data exchanged in a land information network is examined. In the past, major developments have been undertaken to enable the exchange of data between land information systems. A model of a land information network and the data update process have been developed. Based on these, a functional description of the database and software to perform data updating is presented. A prototype of the data update process was implemented using the ARC/INFO geographic information system. This was used to test four approaches to data updating, i.e., bulk, block, incremental, and alert updates. A bulk update is performed by replacing a complete file with an updated file. A block update requires that the data set be partitioned into blocks. When an update occurs, only the blocks which are affected need to be transferred. An incremental update approach records each feature which is added or deleted and transmits only the features needed to update the copy of the file. An alert is a marker indicating that an update has occurred. It can be placed in a file to warn a user that if he is active in an area containing markers, updated data is available. The four approaches have been tested using a cadastral data set. Author

N89-13682# TRW, Inc., Redondo Beach, Calif. Space and Technology Group.
MICROWAVE SCATTERING FROM INTERNAL WAVE MODULATED SURFACE WAVES: A SHIPBOARD REAL APERTURE COHERENT RADAR STUDY IN JOWIP (THE GEORGIA STRAIT EXPERIMENT) Final Report, 1 Jan. 1986 - 27 Jun. 1988

D. S. Kwoh, B. M. Lake, and H. Rungaldier 27 Jun. 1988 52 p
(Contract N00014-86-C-0111)
(AD-A197079; TRW-47691-6001-UT-00) Avail: NTIS HC A04/MF A01 CSCL 17I

A shipboard CW coherent dual-polarized focused radar operating at 9.23 GHz and an optical device which detects the occurrence of specular reflection at the radar incidence angle have been used to investigate mechanisms governing radar backscatter from surface water waves as part of JOWIP (The Georgia Strait Experiment). The relative contributions of Bragg and specular backscatter mechanisms have been identified using the output of the optical specular detector and the radar backscatter polarization ratios. Analysis of the radar data together with data from the DREP laser wave slope gauge has been used to further identify the mechanisms governing radar backscatter and modulations of radar backscatter from surface water waves. It is found that specular reflection is very significant at 20 deg. incidence angle and not negligible at 40 deg. It is found that when specular contributions are absent the relationship between the surface wave slope and the radar backscatter is well-described by Bragg theory. Specular contributions, when they occur, appear as large spikes on top of the Bragg return. GRA

N89-13683# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
QUICK RESPONSE AIRBORNE COMMAND POST COMMUNICATIONS M.S. Thesis
Randy L. Blaisdell 1988 111 p
(AD-A197224; AFIT/CI/NR-88-183) Avail: NTIS HC A06/MF A01 CSCL 25E

National emergencies and strategic crises come in all forms and sizes ranging from natural disasters at one end of the scale up to and including global nuclear warfare at the other. Since the early 1960s the U.S. Government has spent billions of dollars fielding airborne command posts to ensure continuity of government and the command and control function during times of theater conventional, theater nuclear, and global nuclear warfare. Unfortunately, cost has prevented the extension of the airborne command post technology developed for these relatively unlikely events to the lower level, though much more likely to occur, crises such as natural disasters, terrorist acts, political insurgencies, etc. This thesis proposes the implementation of an economical airborne command post concept to address the wide variety of crises ignored by existing military airborne command posts. The system is known as the Quick Response Airborne Command Post (QRAC Post) and is based on the exclusive use of commercially owned and operated aircraft, and commercially available automated data processing and communications resources. The thesis addresses the QRAC Post concept at a systems level and is primarily intended to demonstrate how current technology can be exploited to economically achieve a national objective. GRA

N89-13684# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Science.
A SOFTWARE ARCHITECTURE FOR NETWORK COMMUNICATION Technical Report, 7 Aug. 1984 - 6 Aug. 1987
David P. Anderson 30 Nov. 1987 22 p
(Contract N00039-84-C-0089; ARPA Order 4871)
(AD-A197290) Avail: NTIS HC A03/MF A01 CSCL 12E

A distributed system is based on a layered set of abstractions of network communication. At a low level, current distributed systems use primitives such as datagrams, request/reply message-passing, reliable virtual circuits, or a combination of these. Future distributed systems will use high-performance large-scale communication networks, and will support a range of communication-intensive applications. What are the appropriate communication abstractions for such systems. In answer to this question, we have developed a communication abstraction called Real-Time Message Streams (RMS). An RMS is a simplex (unidirectional) stream with several performance and security parameters. These parameters express: (1) the needs of RMS clients (user programs and communication protocols), and (2) the capabilities of the RMS provider (network and higher layers). This information can be used in two ways. First, RMS providers can eliminate unnecessary or redundant work, and can optimally schedule resources such as network bandwidth and CPU. Second, the RMS client can use the parameters to select optimal methods for achieving whatever reliability and flow control are needed. RMS is the communication primitive of the DASH distributed system currently being developed at UC Berkeley. This paper describes: (1) the RMS abstraction itself, (2) the role of RMS and DASH communication architecture, and (3) techniques and algorithms for providing RMS at various system levels. GRA

N89-13685# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
INTERCONNECTION ALGORITHMS IN MULTI-HOP PACKET RADIO TOPOLOGIES Technical Report, 1 Sep. 1986 - 31 Aug. 1988
P. Papantoni-Kazakos, M. Paterakis, and Liu Ming 31 Aug. 1988 40 p
(Contract N00014-86-K-0742)
(AD-A197433; UVA/525415/EE89/114) Avail: NTIS HC A03/MF A01 CSCL 25B

We consider a two-cluster system in multi-hop packet radio topologies. Each cluster deploys a limited sensing random access algorithm, and contains local users who transmit their packets only via the algorithm in their own cluster. The system also contains marginal users, who may transmit their packers via either one of the algorithms in the two clusters. For the above system, we adopt a limited sensing random access algorithm per cluster that has been previously studied. This algorithm utilizes binary, collision versus noncollision, feedback per slot, and in the presence of the limit Poisson user model and the absence of marginal back per slot, and in the presence of the limit Poisson user model and the absence of marginal users its throughout is 0.43. We consider a dynamic interconnection policy for the marginal users, and we then study the overall system performance in the presence of limit Poisson user populations. Specifically, we study the stability regions of the system and the per packet expected delays. Our interconnection policy accelerates the marginal users, presenting them with a significant delay advantage over the local users. This is desirable when the marginal users transmit high priority data, for example. GRA

N89-13686# Naval Research Lab., Washington, D.C. Electromagnetics Branch.
DESIGN, TEST AND EVALUATION OF A PAIR OF BOOTLACE LENSES Final Report
P. D. Stilwell, Jr., M. G. Parent, H. P. Coleman, and B. D. Wright 6 Jul. 1988 75 p
(AD-A197817; NRL-MR-6204) Avail: NTIS HC A04/MF A01 CSCL 20N

This report concerns the development of a microwave lens of the bootlace type for use as a beamformer for linear, phased array antennas. Such devices prove to be a practical implementation of the type of time delay beamformer required in ECCM systems. They constitute hardware which maps from a sampled (elemental antenna) space to beamspace, where beamspace denotes one of the many discrete sets of directional antenna patterns possible, e.g., a Fourier transform of the antenna samples. Successful implementation of a wide angle, wideband lens places strong conditions on impedance match over frequency and scan direction. Further, operation in beamspace implies the existence of a significant number of beam ports and a commensurate number of antenna elements. GRA

N89-13687# Science Applications International Corp., McLean, Va.
SOVIET HIGH-POWER RADIO FREQUENCY RESEARCH
V. L. Granatstein, J. N. Benford, J. N. Bombardt, A. Gold, B. Levush, G. A. Thiele, V. A. J. vanLint (Mission Research Corp., San Diego, Calif.), Barbara L. McKenney, ed., Moira McGrain, ed., and Renee G. Taub, ed. Jul. 1988 153 p
(FASAC-TAR-4050) Avail: NTIS HC A08/MF A01

A panel of U.S. scientists and engineers assessed Soviet research in high powered microwaves in the early 1980s, as reflected in information released publicly. In the centimeter band, the USSR is far ahead of the U.S. in developing backward wave oscillators (BWOs) at extremely high peak power levels and high efficiency. Soviet scientists are also far ahead in developing repetitively pulsed BWOs and magnetrons, and in compact packaging of these repetitively pulsed generators. In high power millimeter wave devices, Soviet capability is at the forefront in gyrotron development, but lags in free electron laser experiments. Soviet research on gyrotron amplifiers aimed at providing radio frequency power for linear supercolliders has produced a 60 dB amplifier at 7 GHz capable of producing 60 MW output pulses of 0.7 microsec duration. An almost complete absence in recent USSR literature on vircators or on phase locking of high power microwave sources is noted. Only one publication on high power microwave component development or high power microwave propagation was found in recent USSR literature. No mention of testing electronic components for damage by high microwaves was found, although references were made to effects of nuclear electromagnetic pulses. Author

N89-13688# Stanford Univ., Calif. Dept. of Computer Science.
EXPLOITING RECURSION TO SIMPLIFY RPC COMMUNICATION ARCHITECTURES
David R. Cheriton Jun. 1988 13 p
(AD-A198711; SU-STAN-CS-88-1213; CSL-TR-88-360) Avail: NTIS HC A03/MF A01 CSCL 25B

Current communication architectures suffer from a growing collection of protocols in the host operating systems, gateways and applications, resulting in increasing implementation and maintenance cost, unreliability and difficulties with interoperability. The remote procedure call (RPC) approach has been used in some distributed systems to contain the diversity of application layer protocols within the procedure call abstraction. However, the same technique cannot be applied to lower layer protocols without violating the strict notion of layers. In this paper, we show how the RPC approach can be used for lower layer protocols so that the resulting layer violations generate a simple recursive structure. The benefits of exploiting recursion in a communication architecture are similar to those realized from its use as a programming technique; the resulting protocol architecture minimizes the complexity and duplication of protocols and mechanism, thereby reducing the cost of implementation and verification. We also sketch a redesigned DOD Internet architecture that illustrates the potential benefits of this approach. GRA

N89-13689# California Univ., Los Angeles. Dept. of Electrical Engineering.
ADVANCED COMMUNICATION TECHNIQUES Final Report, 1 Jun. 1985 - 31 May 1988
Robert A. Scholtz and Lloyd R. Welch Jul. 1988 74 p
(Contract DAAG29-85-K-0116)
(AD-A198725; ARO-22305.61-EL) Avail: NTIS HC A04/MF A01 CSCL 25E

This report contains a listing of all papers submitted, processed and published. Abstracts are provided for each paper. Ph.D. theses are also listed as well as technical seminars and annual reviews. GRA

N89-13690# Interspec, Inc., Conshohocken, Pa.
SELF-COHERING AIRBORNE DISTRIBUTED ARRAY Final Report, Jan. 1984 - Oct. 1985
E. H. Attia Jun. 1988 49 p
(Contract F19628-84-C-0080)
(AD-A198783; INTERSPEC-R-174; RADC-TR-88-109) Avail: NTIS HC A03/MF A01 CSCL 17I

Several algorithms for self cohering an airborne distributed array on radar clutter have been tested and their performances have been statistically evaluated. Also, several new algorithms have been developed. The new algorithms offer, in general, improved performance and wider applicability. Airborne clutter data was obtained from two sources: the Naval Research Laboratory (NRL) and the Environmental Research Institute of Michigan (ERIM). Specific runs of the 8-element NRL airborne array were identified and obtained. These covered land as well as sea clutter, with different radar look angles, and different pulse repetition rates. Several runs of ERIM SAR data were also obtained. The SAR data was adapted to permit testing of the Minimum Variance and Robust algorithms. The performance of the Minimum Variance algorithm was tested and statistically evaluated using the NRL and ERIM clutter data. The algorithm was successful against land clutter where it was used successfully for finding targets of opportunity that allowed retrodirective beamforming. The algorithm was unreliable (as expected) against sea clutter. Doppler Beamsharpening techniques were also tested against the NRL land clutter data. Doppler Beamsharpening proved to be highly effective in increasing the chance of finding targets of opportunity that allow high quality retrodirective beamforming. GRA

N89-13691# Naval Research Lab., Washington, D.C.
BEARINGS ONLY AIR-TO-AIR RANGING
Robert Rubin and Joseph V. Michalowicz 25 Jul. 1988 78 p
Prepared in cooperation with Sachs/Freeman Associates, Inc., Lanover, Md.
(AD-A198785; NRL-MR-6046) Avail: NTIS HC A05/MF A01 CSCL 17K

Passive infrared search and track (IRST) devices do not provide immediate estimates of a target's location, range and velocity, rather, information on the target in the form of collections of bearings of the target relative to the observer, who himself is in motion. Target parameters, such as location and velocity, are then derived as functions of the bearings. This report presents results of a study of the performance of various air-to-air passive ranging techniques. Attention is concentrated on the cases of a fixed target and a constant velocity target. Range estimation methods are investigated based on least squares fits using all observed bearings, least squares fits using azimuths only, and on minimal estimates using only a selected small number of bearings. Simulations are run to assess the performance of the various methods, with bearings taken at regular intervals and assumed independent Gaussian errors in azimuth and altitude measurements. GRA

N89-13692# Washington Univ., St. Louis, Mo. Electronic Systems and Signals Research Lab.
HIGH RESOLUTION RADAR IMAGING Semiannual Report No. 4, 1 Dec. 1987 - 30 May 1989
Donald L. Snyder 31 May 1988 37 p
(Contract N00014-86-K-0370)
(AD-A198867) Avail: NTIS HC A03/MF A01 CSCL 17I

The goal of this project is to formulate and investigate new approaches for forming images of radar targets from spotlight-mode, delay-Doppler measurements. These measurements could be acquired with a high-resolution radar-imaging system operating with an optical- or radio-frequency carrier. Two approaches are under study. The first is motivated by an image-reconstruction method used in radionuclide imaging called the confidence-weighted algorithm; here, we refer to this approach as the chirp-rate modulation approach. The second approach is based on more fundamental principles which starts with a mathematical model that accurately describes the physics of an imaging radar-system and then uses statistical-estimation theory with this model to derive methods for producing target images; we refer to this as the estimation-theory approach. GRA

N89-13693# Australian National Univ., Canberra. Research School of Earth Sciences.
Lg-WAVE PROPAGATION IN HETEROGENEOUS MEDIA Report No. 1, 15 Feb. 1987 - 14 Feb. 1988
Brian L. Kennett 6 Apr. 1988 41 p
(Grant AF-AFOSR-0187-87; AF Proj. 7A10)
(AD-A198920; AFGL-TR-88-0141) Avail: NTIS HC A03/MF A01 CSCL 08K

The Lg wave phase which is of considerable interest for nuclear discrimination problems is normally observed after propagation

through considerable distances. This phase is dominantly guided in the crustal waveguide, which is known to be a region with very considerable horizontal variability in properties. The effect of heterogeneous crustal structures on Lg waves has been determined by using a coupled-mode technique in which the local seismic wavefield in the real medium is expressed as a combination of the modal eigenfunctions of a stratified reference structure. Departures of the seismic properties in the medium from those of the reference medium lead to coupling between the amplitude coefficients in the modal expansion. The evolution of these modal weighting factors with horizontal position are described by a coupled set of ordinary differential equations. This approach provides a calculation scheme for studying guided wave propagation over extended distances, at frequencies of 1 Hz and above. The heterogeneity models which have been used are two-dimensional and calculations are carried out for one frequency at a time. GRA

N89-13694# Naval Ocean Systems Center, San Diego, Calif.
ELF SCATTERING IN THE EARTH-IONOSPHERE WAVEGUIDE Interim Report, Jan. - Aug. 1988
R. A. Pappert and L. R. Hitney Apr. 1988 128 p
(AD-A198948; NOSC/TD-1275) Avail: NTIS HC A07/MF A01 CSCL 20N

Slab-model implementation of ELF scattering by a cylindrically symmetric but radially varying ionospheric disturbance is explored. The ground-based transmitter and receiver may be located beneath the disturbance or outside its projection on the ground. Amplitudes and phases of the laterally dependent part of all transverse magnetic (TM) field components are calculated as a function of range for a given location of the disturbance or as a function of disturbance location for a fixed range. Although partial sum convergence difficulties limit its general utility, the resulting program can be used for a variety of case studies. Examples given include drifting sporadic-E patches, a nuclear depression, and a weak solar proton event. GRA

N89-13695# Naval Research Lab., Washington, D.C. Target Characteristics Branch.
COHERENT DETECTION OF RADAR TARGETS IN K-DISTRIBUTED, CORRELATED CLUTTER Interim Report
K. J. Sangston 5 Aug. 1988 19 p
(AD-A198990; NRL-9130) Avail: NTIS HC A03/MF A01 CSCL 17I

A processor is obtained for detecting a radar target in correlated, nonhomogeneous Gaussian (K-distributed) clutter. When this processor and a matched filter are excited with nonhomogeneous Gaussian data, the performance of the new processor exceeds that of the matched filter. The new processor was obtained by approximating the Neyman-Pearson test for this problem. GRA

N89-13696# Mitre Corp., Bedford, Mass.
AN INVESTIGATION OF ARQ (AUTOMATIC REQUEST FOR RETRANSMISSION) AND HYBRID FEC-ARQ (FORWARD ERROR CORRECTION) ON AN EXPERIMENTAL HIGH LATITUDE METEOR BURST CHANNEL Final Report
Kenneth Brayer and Subramaniam Natarajan Jun. 1988 47 p
(Contract F19628-86-C-0001)
(AD-A198992; MTR-10323; ESD-TR-88-263) Avail: NTIS HC A03/MF A01 CSCL 20N

In this paper an investigation of error control coding techniques on an experimental northern latitude meteor burst link is presented. Bit error patterns were obtained and the performance of automatic request for retransmission (ARQ) and hybrid forward error correction (FEC) with ARQ were examined from the standpoint of probability of message delivery and encountered delays with respect to the message delivery. GRA

N89-13697# Naval Research Lab., Washington, D.C. Target Characteristics Branch.
INVESTIGATION OF THE SPECTRAL DECOMPOSITION OF QUADRATURE ERROR SIGNALS Interim Report
C. C. Faurer 12 Aug. 1988 43 p
(AD-A199000; NRL-MR-6258) Avail: NTIS HC A03/MF A01 CSCL 12I

This technical report presents the results of an investigation of the performance of band-partitioning filters when the complex signals being transformed contain quadrature errors. Phase and amplitude errors between the in-phase (I) and quadrature-phase (Q) components of a signal can cause significant degradation in the performance of a receiver system. Therefore, it is important to demonstrate how the output of band-partitioning filters, in this case formed by the discrete Fourier transform, are affected by signals with these types of perturbations. Computer simulations are used for this purpose. Because of the effect of quadrature errors on the system (not described in this report), band partitioning was performed separately on I and Q signal components. In addition to the DFT, Hadamard and Hartley transforms were employed and corresponding responses to swept frequency signals reveal interesting differences. GRA

N89-13698# Sandia National Labs., Albuquerque, N. Mex. Signal Analysis Div.
VOLUMETRIC RADAR CROSS SECTION OF SINGLE TREE CALCULATED FROM FAR-FIELD S-BAND MEASUREMENTS
Mary Jane Hicks Aug. 1988 45 p
(Contract DE-AC04-76DP-00789)
(DE88-016497; SAND-88-2194) Avail: NTIS HC A03/MF A01

Backscatter radar cross section per unit volume of a single tree was calculated from far-field S-band measurements of radar cross section. The measurements were made at the SCATTER facility at Sandia National Laboratories, Albuquerque, New Mexico. The trees measured were an 11-ft (3.4-m) Austrian pine and a 22-ft (6.7-m) budding Modesto ash. Radar cross section of the pine was also measured after the needles had been stripped from the tree. The mean radar cross section per unit volume of the pine was -12 dBsm/m³; the absence of needles had no significant effect on this result. The mean radar cross section per unit volume of the Modesto ash was -18 dBsm/m³. DOE

N89-13699# Illinois Univ., Urbana. Coll. of Engineering.
WORST CASE ENCODER-DECODER POLICIES FOR A COMMUNICATION SYSTEM IN THE PRESENCE OF AN UNKNOWN PROBABILISTIC JAMMER M.S. Thesis
David M. Cascio May 1988 59 p
(Contract N00014-84-C-0149)
(AD-A198244; UILU-ENG-88-2243; DC-107) Avail: NTIS HC A04/MF A01 CSCL 17D

States of nature or observed data are often stochastically modelled as Gaussian random variables. At times it is desirable to transmit this information from a source to a destination with minimal distortion. Complicating this objective is the possible presence of an adversary attempting to disrupt this communication. In this report, solutions are provided to a class of minimax and maximin decision problems, which involve the transmission of a Gaussian random variable over a communications channel corrupted by both additive Gaussian noise and probabilistic jamming noise. The jamming noise is termed probabilistic in the sense that with nonzero probability 1-P, the jamming noise is prevented from corrupting the channel. We shall seek to obtain optimal linear encoder-decoder policies which minimize given quadratic distortion measures. GRA

N89-13700# Naval Postgraduate School, Monterey, Calif.
NAVY SATELLITE COMMUNICATIONS IN THE HELLENIC ENVIRONMENT M.S. Thesis
Athanasios Economou Jun. 1988 148 p
(AD-A198390) Avail: NTIS HC A07/MF A01 CSCL 25B

This thesis covers the history of satellite communications from its beginning in 1957 until recent years, describes the space subsystem and explains the major components of satellite communications. It defines the practical problems of satellite communications such as radiation and frequency dependence attenuation. It also examines certain aspects of satellite communications in the Hellas environment including reliability and

survivability in a hostile environment. The last chapter outlines the major decisions and evaluation required for a tactical satellite system for the Hellenic Navy. GRA

N89-13701*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
RADIATION AND SCATTERING FROM LOADED MICROSTRIP ANTENNAS OVER A WIDE BANDWIDTH
D. P. Forrai and E. H. Newman Sep. 1988 103 p
(Grant NsG-1613)
(NASA-CR-181314; NAS 1.26:181314; TR-719493-1) Avail: NTIS HC A06/MF A01 CSCL 20N

The integral equation and moment method solution is developed for two different antennas in the presence of an infinite grounded dielectric substrate. The first antenna is a rectangular microstrip patch antenna. This antenna is analyzed for excitation by an incident plane wave in free space and a vertical filament of uniform current in the dielectric. This antenna can be loaded by a lumped impedance in a vertical filament of uniform current extending from the patch through the dielectric to the ground plane. The radar cross section of the microstrip antenna is found from the plane wave excitation and shows good agreement to measurement for both an unloaded and loaded antenna. The input impedance is found from the current filament excitation. This is compared to the measured input impedance of a coaxially fed microstrip antenna and shows good agreement for both unloaded and loaded antennas when the dielectric substrate is much less than a wavelength. The second antenna is a vertical thin wire extending from the ground plane into or through the dielectric substrate. The mutual impedance between two imbedded monopoles is compared to a previous calculation. Author

N89-14168*# University of Central Florida, Orlando.
TRANSMISSION OF MULTIPLEXED VIDEO SIGNALS IN MULTIMODE OPTICAL FIBER SYSTEMS
Preston White, III *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 455-485 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 17B

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N89-13702# Space Technology Corp., Fort Collins, Colo.
HIGH SPEED CASCADABLE SIGNAL PROCESSING CIRCUITS Final Technical Report, 16 Sep. 1987 - 15 Mar. 1988
Michael Andrews, Octavio Morales, and Bradley Hamilton 29 Apr. 1988 92 p
(Contract DAAD07-87-C-0102)
(AD-A197078) Avail: NTIS HC A05/MF A01 CSCL 09A

Signal-processing algorithms are multiply/accumulate intensive. An Expandable Vector Accelerator (EVA) architecture is presented which incorporates novel computing methods using advanced IC devices. This architecture is capable of executing speed-intensive radar-signal processing and spread-spectrum processing tasks including FFT, LMS, LS, convolution, correlation, and spectrum analysis. Preliminary board-level designs have been developed to integrate specialized high-speed, cascadable signal processing circuits to process a myriad of real time algorithms. Typical applications for the EVA include range and range-rate data processing, digital focusing, real time Kalman filtering, real time Target Motion Resolution (TMR) processing of MPS-36 and FPS-16 radars data, and processing image/pattern information for real time, multimunitions scenes optical trackers. GRA

N89-13703# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ULTRAVIOLET-INDUCED FLASHOVER OF HIGHLY-ANGLED POLYMERIC INSULATORS IN VACUUM Ph.D. Thesis
Carl L. Enloe 1988 171 p
(AD-A197147; AFIT/CI/NR-88-105) Avail: NTIS HC A08/MF A01 CSCL 07F

The flashover of electrically stressed polymeric insulators in vacuum induced by exposure to intense ultraviolet radiation was investigated. Two geometries, positive and negative 45 degrees, were studied at electric field stresses of up to 80 kV/cm. Insulating materials tested were polystyrene, acrylic, nylon-6, acetal, PVC, and teflon. A krypton fluoride excimer laser at a wavelength of 248 nm provided the ultraviolet illumination. Ultraviolet-induced flashover over polymeric insulators in vacuum depends on the ultraviolet fluence (energy density) incident on the insulator surface. The negative-angle (unconventional) configuration exhibits superior ultraviolet tolerance compared to the positive-angle (conventional) configuration by approximately a factor of two in fluence. Insulating materials with high dielectric constants and low secondary electron emission coefficients exhibit superior ultraviolet tolerance. A model of ultraviolet-induced insulator flashover based on induced charging of the insulator surface is sufficient to explain the observed phenomena. GRA

N89-13704# Utah Univ., Salt Lake City. Dept. of Physics.
A REVIEW OF NOISE STUDIES IN SUPERIONIC ELECTROLYTES Technical Report No. 18, Oct. 1987 - Jul. 1988
Chu K. Kuo and James J. Brophy Jul. 1988 35 p Submitted for publication
(Contract N00014-82-K-0603)
(AD-A197206) Avail: NTIS HC A03/MF A01 CSCL 07B

Electrical noise and its measurement in superionic solid electrolytes is reviewed. The essential noise generation is associated with thermal agitation, diffusion and electrochemical reaction of mobile ions in the bulk superionic electrolyte and at interfacial contacts. Simulation calculations display the superposed patterns of different noise sources and their resolution. Recent experimental results on sodium beta double prime alumina and Nasicon are present. GRA

N89-13705# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
TOTAL DOSE RESPONSE OF SILICON-ON-INSULATOR (SOI) METAL-OXIDE-SEMICONDUCTOR FIELD-EFFECT TRANSISTOR'S (MOSFET'S) M.S. Thesis
Mark C. Biwer Jun. 1988 80 p
(AD-A197216; AFIT/CI/NR-88-167) Avail: NTIS HC A05/MF A01 CSCL 09A

Total dose response of both NMOS and PMOS FET's fabricated on SIMOX and ZMR substrates was studied. Two types of back channel leakage currents were identified for the SIMOX devices. A back channel leakage due to MOSFET action uses the substrate bias as the gate bias. The other component is due to soft reverse characteristics of the body-drain junction. The back channel leakage due to MOSFET action varies with the substrate bias and thus varies with irradiation due to threshold voltage shift. The soft reverse current is a function of drain-body voltage and hence varies with substrate bias and irradiation. The threshold voltage, I-V characteristics, and subthreshold currents of both front and back channels as a function of total dose were obtained. GRA

N89-13706*# GTE Labs., Inc., Waltham, Mass.
STUDY OF OPTOELECTRONIC SWITCH FOR SATELLITE-SWITCHED TIME-DIVISION MULTIPLE ACCESS
Shing-Fong Su, Liz Jou, and Joe Lenart 24 Jun. 1987 73 p
(Contract NAS3-24673)
(NASA-CR-179630; NAS 1.26:179630) Avail: NTIS HC A04/MF A01 CSCL 09A

The use of optoelectronic switching for satellite switched time division multiple access will improve the isolation and reduce the crosstalk of an IF switch matrix. The results are presented of a

study on optoelectronic switching. Tasks include literature search, system requirements study, candidate switching architecture analysis, and switch model optimization. The results show that the power divided and crossbar switching architectures are good candidates for an IF switch matrix. Author

N89-13707# Linton and Co., Inc., Washington, D. C.
A BACKPROJECTION ALGORITHM FOR ELECTRICAL IMPEDANCE IMAGING Final Report
Fadil Santosa and Michael Vogelius Jul. 1988 35 p Prepared in cooperation with Delaware Univ., Newark
(Contracts N00014-85-K-0725; N00014-85-K-0169; NSF DMS-87-20428; NSF DMS-86-01490)
(AD-A198680; BN-1081) Avail: NTIS HC A03/MF A01 CSCL 20C

We study a two-dimensional reconstruction algorithm due to D. C. Barber and B. H. Brown, applied to a linearized electrostatic inverse problem. Firstly we demonstrate how this algorithm fits within the framework of inverses of generalized Radon transforms studied by G. Beylkin. Secondly we construct an iterative improvement of the Barber-Brown algorithm based on the conjugate residual method. We present several numerical results obtained with this iterative algorithm. GRA

N89-13708# Case Western Reserve Univ., Cleveland, Ohio. Center for Electrochemical Sciences.
THEORETICAL MODELLING OF CELL AND BATTERY CHARACTERISTICS AT SHORT TIMES/HIGH FREQUENCIES Interim Technical Report
M. L. Daroux, B. D. Cahan, and E. B. Yeager 16 Jun. 1988 9 p Prepared in cooperation with Eveready Battery Co., Westlake, Ohio
(Contract N00014-86-C-0808)
(AD-A198741; TR-2) Avail: NTIS HC A02/MF A01 CSCL 10C

The design of batteries intended to deliver very high current pulses with rise time on the order of microseconds requires consideration of factors usually neglected in conventional battery design. In previous work we have shown that the short time/high frequency response of a physically large battery may be significantly limited by geometric and physical factors. In constructing theoretical models which can be used to evaluate design factors in pulse batteries, it is therefore necessary to take into account the whole battery, the internal and external connections, and eventually the load itself. On the basis of a modelling study which takes some of these factors into consideration, this paper describes the design implications of geometric and physical variables such as electrodes and electrolyte resistivity, electrolyte thickness and cell length. GRA

N89-13709# Naval Electronic Systems Engineering Activity, St. Inigoes, Md. Electromagnetic Engineering Branch.
INVESTIGATION OF AIRCRAFT POWERLINE TRANSIENTS, PHASE 4 Final Report, Nov. 1982 - Jan. 1987
L. R. Bachman 1 Feb. 1988 72 p
(AD-A198918) Avail: NTIS HC A04/MF A01 CSCL 20C

An investigation into the extent and nature of switching transients on aircraft powerlines showed that both on ground and in-flight conditions are similar. The data also indicated that, of the transients resulting from switching operations and lasting less than 50 microseconds, more than 95 percent are similar to damped sinusoidal waveforms or unipolar waveforms; all are below 200V peak on the 115 Vac bus (400 Hz) and 24V peak on the 28 Vdc bus; 94 percent are below 25V on the 115 Vac (400 Hz) bus; and 82 percent are below 0.5V on the 28 Vdc bus. Based on the findings, for test method CE07 in MIL-STD-461, Part 2 (Aircraft), the present levels are adequate and should be retained. For test method CS06, the requirements should be modified to include two damped sinusoidal waveforms having a Q of 6, frequencies of 1.0 and 10.0 MHz and a peak amplitude at 200V for 115 Vac, 400 Hz powerlines. This requirement should also be added for 28 Vdc lines; however, the amplitude should be reduced to 24V peak. The unipolar pulse with the present time durations should be retained except that the amplitude for the dc powerline should be reduced to 24V peak. GRA

N89-13710# Tel-Aviv Univ. (Israel). School of Chemistry.
ADVANCED CALCIUM THIONYL CHLORIDE HIGH POWER BATTERY Periodic Report No. 2, 23 Feb. - 24 Jun. 1988
Emanuel Peled 25 Jul. 1988 40 p
(Contract DAJA45-88-C-0012)
(AD-A199035; R/D-5899-CH-01-2) Avail: NTIS HC A03/MF A01 CSCL 10C

We have made a breakthrough in the development of two advanced calcium thionyl chloride systems which have much better storage properties than the state-of-the-art Ca-SOC12 cell. This has been done by replacing the CaX2 (X=A1C14) electrolyte by SrX2 (type A), or BaX2 (type B). The project's goals are to gain a better understanding of the electrochemistry of the advanced systems and to establish their safety and performance. We present results regarding the properties of MX2-sulfur dioxide-TC solutions (M = calcium, strontium, barium), including Raman spectra, viscosity, and conductivity data. We explain the effect of SO2 and temperature on the conductivity and conduction mechanism. We studied the effect of 70 C storage on performance of the baseline (C-size) cell. A fresh cell delivered, at room temperature, 3.4 Ah and 3.2 Ah on 10 and 4 ohm load respectively. It lost 20 and 55 percent or more capacity after two and four weeks of storage at 70 C, much more than type A cell. Short circuit, heavy load and reversal tests of type A cells ended with no cell venting or leaking. Ampule corrosion tests of calcium foils in type A electrolyte reveal 0.5 to 3 percent corrosion after four weeks of storage at 70 C. This indicates that a room temperature shelf life of more than ten years is feasible for type A system. GRA

N89-13711# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
INTRINSIC MECHANISMS OF MULTI-LAYER CERAMIC CAPACITOR FAILURE Final Report, 15 Mar. 1983 - 14 May 1988
L. C. Burton Jul. 1988 62 p
(Contract N00014-83-K-0168)
(AD-A199113) Avail: NTIS HC A04/MF A01 CSCL 20C

Studies related to leakage currents and intrinsic degradation of multilayer ceramic capacitors and related materials were performed. For the X7R materials studied, the following results confirmed that the charge carrier for current is the electron: constant leakage current; negative thermoelectric voltage; negligible galvanic voltage; presence of space charge limited current. Thermal activation energies decreased with voltage for barrier layer, COG and Z5U types, but not for X7R. Such voltage dependence, accompanied by superohmic current, is indicative of grain boundary (GB) dominated transport. Complex impedance plots give evidence of several resistive contributions, which could be attributed to grains and GB. Modelling of GB impedance indicates the importance of grain size homogeneity and grain curvature. GRA

N89-13712# General Electric Co., Largo, Fla. Neutron Devices Dept.
SURFACE FLASHOVER OF INSULATORS
H. Craig Miller 31 Aug. 1988 46 p
(Contract DE-AC04-76DP-00656)
(DE88-017290; GEPP-TIS-1064) Avail: NTIS HC A04/MF A01

This paper reviews surface flashover (i.e., voltage breakdown along the surfaces of insulators), primarily in vacuum, although some comments are made about surface/flashover in high pressure gases. Theories and models relating to surface flashover are discussed, along with pertinent experimental results. Also, some suggestions are made regarding how to choose the material, geometry, and processing when selecting an insulator for a particular application. DOE

N89-13713# General Electric Co., Largo, Fla. Neutron Devices Dept.
A REVIEW OF ANODE PHENOMENA IN VACUUM ARCES
H. Craig Miller Sep. 1988 44 p
(Contract DE-AC04-76DP-00656)
(DE88-017304; GEPP-TIS-1076) Avail: NTIS HC A03/MF A01

This report discusses arc modes at the anode, experimental results pertinent to anode phenomena, and theoretical explanations of anode phenomena. The dominant mechanism controlling the formation of an anode spot appears to depend upon the electrode geometry, the electrode material, and the current waveforms of the particular vacuum arc being considered. In specific experimental conditions, either magnetic constriction in the gap plasma or gross anode melting or local anode evaporation can trigger the transition. However, the most probable explanation of anode spot formation is a combination theory, which considers magnetic constriction in the plasma together with the fluxes of material from the anode and cathode as well as the thermal, electrical, and geometric effects of the anode in analyzing the behavior of the anode and the nearby plasma. DOE

N89-13714# California Univ., Berkeley. Lawrence Berkeley Lab.
FABRICATION OF DETECTORS AND TRANSISTORS ON HIGH-RESISTIVITY SILICON
Steve Holland Jun. 1988 17 p Presented at the Workshop on Pixel Detectors, Leuven, Belgium, 31 May 1988
(Contract DE-AC03-76SF-00098)
(DE88-016240; LBL-25520; CONF-8805193-1) Avail: NTIS HC A03/MF A01

A new process for the fabrication of silicon p-i-n diode radiation detectors is described. The utilization of backside gettering in the fabrication process results in the actual physical removal of detrimental impurities from critical device regions. This reduces the sensitivity of detector properties to processing variables while yielding low diode reverse-leakage currents. In addition, gettering permits the use of processing temperatures compatible with integrated-circuit fabrication. P-channel MOSFETs and silicon p-i-n diodes have been fabricated simultaneously on silicon using conventional integrated-circuit processing techniques. DOE

N89-13715# Brookhaven National Lab., Upton, N. Y. Accelerator Development Dept.
PART 1: CABLE INSULATION DEVELOPMENT. PART 2: SUPERCONDUCTING POWER TRANSMISSION SYSTEM DEVELOPMENT Annual Report, 1 Oct. 1986 - 30 Sep. 1987
May 1988 18 p
(Contract DE-AC02-76CH-00016)
(DE88-016446; BNL-52154-Pt-1/2; TN-164-Pt-1/2) Avail: NTIS HC A03/MF A01

This report discusses developments in the following areas: superconducting power transmission systems; cable insulation using polymeric tapes; ambient cable insulation; and construction and electrical testing of cable R-903. DOE

N89-13716# SRI International Corp., Menlo Park, Calif.
DEVELOPMENT OF ANODE ALLOYS FOR ALUMINUM/AIR BATTERIES Final Report
Digby D. Macdonald, Silvia Real, and Mirna Urquidi-Macdonald Apr. 1988 94 p Prepared for California Univ., Berkeley, Lawrence Berkeley Lab.
(Contract DE-AC03-76SF-00098)
(DE88-017188; LBL-25091) Avail: NTIS HC A05/MF A01

The electrochemistry of various Al-Li-In, Al-Li-In-Bi, and Al-Mg-Mn-In alloys in 4 M KOH at 50 C has been investigated by delineating the partial anodic and cathodic processes as a function of potential. The Al-Li-In alloys (Group 1) and the Al-Li-In-Bi alloys (Group 2) exhibit high corrosion rates under open circuit conditions and do not display activation phenomena as the potential is swept in the negative to positive direction. Accordingly, these alloys are judged to be unsuitable as fuels for alkaline aluminum/air batteries. The Al-Mn-Mg-In alloys (Group 3) do exhibit activation at potential within the range -1.75 to -1.85 V (vs Hg/HgO, 4 M KOH) as a result of oxidation of manganese from the surface to form a soluble product. These alloys display significantly lower open circuit corrosion rates. All the alloys in this group passivate at more positive potentials, followed by a region over which the current varies nearly linearly with voltage. These same characteristics are exhibited by Alloy BDW (Al-lMg-0.1 In-0.2 Mn), which we investigated previously. However, none of the alloys studied in the present program appears to offer any advantages over Alloy BDW as a fuel for alkaline aluminum/air batteries. We have also continued to analyze various mechanisms to account for the extensive electrochemical impedance data for pure aluminum in 4 M KOH at 25 C. Six mechanisms were explored, including some that involve autocatalytic steps in the aluminum electrodissolution process. None of these mechanisms appears to be capable of accounting for the measured impedance any better than the simple irreversible coupled dissolution/hydrogen ion-atom evolution mechanism reported earlier. DOE

N89-13717# Lawrence Livermore National Lab., Calif.
ALUMINUM-AIR BATTERY: SYSTEM DESIGN ALTERNATIVES AND STATUS OF COMPONENTS
A. Maimoni 15 Sep. 1988 107 p
(Contract W-7405-eng-48)
(DE89-000402; UCRL-53885) Avail: NTIS HC A06/MF A01

This report summarizes the status of the various components of the aluminum-air battery system developed for the U.S. Department of Energy Technology Base Project for Electrochemical Energy Storage from 1978 to mid-1987, and presents results of system analysis. Preliminary information indicated that the concentration of carbon dioxide in the incoming air will need to be reduced to 5--100 ppM. A detailed calculation was performed to predict the performance of a full-size-vehicle system with 6-m^2 air-cathode surface area; results showed that previous estimates of system performance are reasonable and consistent with currently available components. DOE

N89-13718# Sandia National Labs., Albuquerque, N. Mex.
EFFECTS OF RADIATION ON MICROELECTRONICS AND TECHNIQUES FOR HARDENING
Paul V. Dressendorfer 1988 16 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988
(Contract DE-AC04-76DP-00789)
(DE89-001227; SAND-88-2722C; CONF-881151-10) Avail: NTIS HC A03/MF A01

Total dose damage, displacement damage, and single particle events can cause microelectronic circuits to cease to function properly. The tolerance of an integrated circuit to radiation damage can be affected by a large number of factors, including the irradiation conditions, postirradiation conditions, transistor characteristics, and circuit design. Improvements in hardness can be achieved by proper fabrication techniques (including minimization of gate oxide thickness, processing temperatures, and the use of hydrogen for MOS devices) and appropriate design considerations. DOE

N89-13719# Lawrence Livermore National Lab., Calif.
FUNDAMENTAL LIMITATIONS AND TRADE-OFFS FOR HIGH POWER MICROWAVE GENERATION WITH PHOTOCONDUCTORS
Michael D. Pocha 25 Apr. 1988 19 p
(Contract W-7405-eng-48)
(DE89-001468; UCID-21458) Avail: NTIS HC A03/MF A01

There has recently been much interest in photoconductive devices as high speed, low jitter, high power switches for use in high power microwave generation systems. While photoconductive switches are very promising devices there are some fundamental limits and trade-offs which must be considered in attempting to apply them to high power microwave generation. The purpose of this report is to describe the more important of these fundamental limits and trade-offs and to present some criteria for comparison of various circuit and system approaches. DOE

N89-13720# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
PICOSECOND PHOTOCONDUCTIVE SAMPLING MEASUREMENTS OF THE SCATTERING PARAMETERS OF HIGH-SPEED FIELD-EFFECT TRANSISTORS
Steven C. Moss and Duane D. Smith 22 Aug. 1988 58 p
(Contract F04704-85-C-0086)
(AD-A197966; TR-0086A(2945-06)-2; SD-TR-88-82) Avail: NTIS HC A04/MF A01 CSCL 09A

Described are stimulus-response measurement techniques based on the photoconductive generation and sampling of picosecond electrical pulses for measuring the high-frequency scattering parameters of high-speed microwave devices. These techniques are compared with more conventional microwave diagnostic techniques. GRA

N89-13721# Technische Univ., Vienna (Austria). Inst. fuer Technische Elektrochemie.
IMPEDANCE STUDIES OF THE CELL Ag/AgI/Ag BETA ALUMINA/AgI/Ag Technical Report No. 15, Aug. 1987 - Aug. 1988
M. W. Breiter, H. Drstak, and M. Maly-Schreiber 1 Jul. 1988 11 p
(Contract N00014-83-K-0498)
(AD-A198254; Rept-15) Avail: NTIS HC A03/MF A01 CSCL 07B

The construction of the cell Ag/AgI/Ag beta alumina/AgI/Ag is described. The impedance of this cell was measured between .001 and 10000 Hz at temperatures between 20 and 550 C. At temperatures below 100 C the cell impedance is determined to a large extent by the bulk resistance of the AgI layer and to a smaller extent by the impedance of the interface Ag/AgI. At temperatures between 160 and 350 C the impedance is controlled by the bulk resistance of the Ag beta alumina and an impedance due to contact problems between Ag and AgI. The bulk resistance of the beta' alumina becomes predominant between 350 and 550 C. A hindrance due to the transfer of silver ions from AgI to Ag beta' alumina was not observable in the whole temperature range. GRA

N89-13722*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARACTERIZATION OF ZrO2 BUFFER LAYERS FOR SEQUENTIALLY EVAPORATED Y-Ba-CuO ON Si AND Al2O3 SUBSTRATES
George J. Valco, Norman J. Rohrer (Ohio State Univ., Columbus.), John J. Pouch, Joseph D. Warner, and Kul B. Bhasin Nov. 1988 12 p Presented at the Conference on Science and Technology of Thin Film Superconductors, Colorado Springs, Colo., 14-18 Nov. 1988; sponsored in part by DOE, SERI, NBS, NRL, and LBL
(NASA-TM-101432; E-4536; NAS 1.15:101432) Avail: NTIS HC A03/MF A01 CSCL 09A

Thin film high temperature superconductors have the potential to change the microwave technology for space communications systems. For such applications it is desirable that the films be formed on substrates such as Al2O3 which have good microwave properties. The use of ZrO2 buffer layers between Y-Ba-Cu-O and the substrate has been investigated. These superconducting films have been formed by multilayer sequential electron beam evaporation of Cu, BaF2 and Y with subsequent annealing. The three layer sequence of Y/BaF2/Cu is repeated four times for a total of twelve layers. Such a multilayer film, approximately 1 micron thick, deposited directly on SrTiO3 and annealed at 900 C for 45 min produces a film with a superconducting onset of 93 K and critical temperature of 85 K. Auger electron spectroscopy in conjunction with argon ion sputtering was used to obtain the distribution of each element as a function of depth for an unannealed film, the annealed film on SrTiO3 and annealed films on ZrO2 buffer layers. The individual layers were apparent. After annealing, the bulk of the film on SrTiO3 is observed to be fairly uniform while films on the substrates with buffer layers are less uniform. The Y-Ba-Cu-O/ZrO2 interface is broad with a long Ba tail into the ZrO2, suggesting interaction between the film and the buffer layer. The underlying ZrO2/Si interface is sharper. The detailed Auger results are presented and compared with samples annealed at different temperatures and durations. Author

N89-14163*# Puerto Rico Univ., San Juan. Dept. of Electrical Computer Engineering.
MEASUREMENTS OF INDUCED VOLTAGES AND CURRENTS IN A DISTRIBUTION POWER LINE AND ASSOCIATED ATMOSPHERIC PARAMETERS
Julio Santiago-Perez *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 251-310 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N89-13723 Nottingham Univ. (England).
DISCHARGE COEFFICIENT OF FILM COOLING HOLES WITH ROUNDED ENTRIES OR EXITS Ph.D. Thesis
A. Khaldi 1987 251 p
Avail: Univ. Microfilms Order No. BRD-80505

Experimental and theoretical studies are presented for the effects on discharge coefficent of radiusing the inlets or exits of film cooling holes, both in the absence and in the presence of crossflow. The coefficient of discharge (Cd) in the absence of crossflows was found to increase with inlet radiusing by up to 16 percent for normal holes and 30 percent for 30 degree inclined holes. The internal and external crossflow effects on the pressure drop across the holes were expressed as additional loss coefficients. This approach was used to correlate data when crossflows were present for radiused as well as sharp-edged inlets and exits. The use of the additive loss approach was found to lead to satisfactory predictions of discharge coefficients over the range of rounding and crossflows considered. The predictions showed that Cd was independent of mainstream temperature confirming previous experimental results. Comparisons with these results showed good agreement for the 30 degree inclined holes, but differences of up to 30 percent occurred for the normal holes. A computational fluid dynamics program call PHOENICS, was used to provide two- and three-dimensional solutions of a jet issuing perpendicularly into a crossflow and that of a crossflow at a 90 degree hole entry. Solutions were obtained with sharp-edged and with rounded hole entry and exit. The effect of the crossflow on the flow inside the hole was examined for both flow situations considered. Coefficient of discharge data as well as data of crossflow loss coefficient were obtained and compared with the present experimental results. Dissert. Abstr.

N89-13724 Council for National Academic Awards (England).
HEAT TRANSFER WITHIN CONVERGING AND DIVERGING ANNULAR PASSAGES Ph.D. Thesis
Mark R. Butcher 1987 277 p
Avail: Univ. Microfilms Order No. BRD-81426

The study aimed to detemine experimentally the local heat transfer for coefficient and pressure drop for low mass flows within converging, divering, and parallel annular ducts related to recuperative burners, with the simultaneous development of the hydrodynamics and thermal boundary layer. Three hydraulic diameters at entry were used for the converging sections and three for the diverging ones. A parallel annulus for each hydraulic diameter used was also tested for use in comparing the results. Heat flux was applied at the inner surface only. The experimental design of the experiments, experimental rigs, and test models are

discussed and the development of the liquid crystals/heater technique to enable heat transfer trends to be observed through the distribution of colors. Results are presented in tabular form and as nondimensional groups. These are discussed and reasons put forward for the trends obtained together with supporting evidence. A Monte Carlo method is used to calculate the discrimination in the experimental results. Dissert. Abstr.

N89-13725 Johns Hopkins Univ., Baltimore, Md.
A SIMILARITY MODEL OF NONLINEAR CONVECTION Ph.D. Thesis
Alan Meyer Shapiro 1987 142 p
Avail: Univ. Microfilms Order No. DA8807469

The nonlinear equations for a steady axisymmetric convective flow of an incompressible fluid over a horizontal plate are analyzed using a similarity relation used in the study of geophysical vortices. The principal assumption of this model is that the components of the fluid velocity field decrease inversely with distance from a point singularity located at the intersection of the axis of symmetry and the plate. Although the tangential velocity component around the vertical axis is assumed to be zero, the model can be generalized to include unsteady swirling motion. The inverse distance scaling for the velocity field transforms the Navier-Stokes equations into a set of nonlinear ordinary differential equations in the polar angle. No slip and impermeability conditions are imposed along the flat plate. Along the axis we exclude fluid sources and require that stresses be finite. In closing the model, it is convenient to specify to solenoidal term of the vorticity equation explicitly as a function of the polar angle and distance from the point singularity. After computing the velocity field and assuming a relevant equation of state, consideration of the energy equation then leads to a computation of the heating required to maintain the flow. Dissert. Abstr.

N89-13726*# Wright State Univ., Dayton, Ohio. Dept. of Mechanical Systems Engineering.
COMPUTATIONAL AND THEORETICAL ANALYSIS OF FREE SURFACE FLOW IN A THIN LIQUID FILM UNDER ZERO AND NORMAL GRAVITY Interim Report
Amir Faghri and Theodore D. Swanson 20 Oct. 1988 153 p
(Grant NAG5-956)
(NASA-CR-180229; NAS 1.26:180229) Avail: NTIS HC A08/MF A01 CSCL 20D

The results of a numerical computation and theoretical analysis are presented for the flow of a thin liquid film in the presence and absence of a gravitational body force. Five different flow systems were used. Also presented are the governing equations and boundary conditions for the situation of a thin liquid emanating from a pressure vessel; traveling along a horizontal plate with a constant initial height and uniform initial velocity; and traveling radially along a horizontal disk with a constant initial height and uniform initial velocity. B.G.

N89-13727# Ballistic Research Labs., Aberdeen Proving Ground, Md.
INTERNAL PRESSURE MEASUREMENTS FOR A LIQUID PAYLOAD AT LOW REYNOLDS NUMBERS
David J. Hepner, Keith P. Soencksen, Bradford S. Davis, and Nicholas G. Maiorana Jun. 1988 63 p
(AD-A197438; AD-E900740; BRL-MR-3674) Avail: NTIS HC A04/MF A01 CSCL 01A

Spin-stabilized projectiles can experience poor flights due to the influence of liquid payloads. Substantial analytical and numerical work has been done on this problem, but quality experimental data on the primitive variables of the liquid (pressure and velocity) are still required to evaluate the accuracy and applicability of models and codes. In free gyroscope tests for Reynolds numbers less than 100, the broadening effect of low Reynolds numbers is also evident. Evidence of related liquid instabilities for actual flight data was reported. A full-scale three-degree-of-freedom flight simulator was used to examine both endwall and sidewall pressure fluctuations, as well as the phase relationship between the maximum pressure and cylinder orientation for a high Reynolds number of 18,200. Scale simulations of high viscosity liquid payloads were completed for a Reynolds number range of 3.1 to 8.9. Testing included establishing instrumentation reliability, repeating previously published low Reynolds number data, expanding the range in nondimensional coning frequency and Reynolds number, and providing a data base for comparisons with current linear theory applications at low Reynolds number. Based on these preliminary results, extensive testing can be accomplished on the BRL Flight Simulator using a full-scale cylinder and larger instrumentation payload capacity. GRA

N89-13728*# National Aeronautics and Space Administration. Pasadena Office, Calif.
MULTI-ELEMENT SPHERICAL SHELL GENERATION Patent Application
Andrew D. Morrison, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 29 Aug. 1988 15 p
(Contract NAS7-918)
(NASA-Case-NPO-17203-1-CU; NAS 1.71:NPO-17203-1-CU; US-Patent-Appl-SN-250195) Avail: NTIS HC A03/MF A01 CSCL 20D

A nozzle assembly in a multi-element spherical shell generation system includes first and second side-by-side spaced apart nozzles and a web portion extending between and connecting the nozzles. The first nozzle has an inner orifice adapted to discharge a first filler material and an outer annular orifice separated from and defined in concentric relation about the inner orifice and adapted to discharge a first shell material. The second nozzle has an inner orifice adapted to discharge a second filler material and an outer annular orifice separated from and defined in concentric relation about the inner orifice and adapted to discharge a second shell material. A multi-element spherical shell can be formed through employment of the nozzle assembly by merger with one another after discharge from the outer orifices of the nozzles of a pair of adjacent annular streams of liquid or molten shell wall material of different compositions and encapsulation by the mixed shell wall materials of a common encapsulated core fluids also simultaneously discharged by the inner orifices nozzles. On the other hand, the pair of encapsulating streams of shell wall material can be of the same materials which merge together and encapsulate core fluids of different compositions which will merge together after discharge from the nozzles. NASA

N89-13729*# Pavia Univ. (Italy). Dipt. di Matematica.
ON THE COUPLING OF HYPERBOLIC AND PARABOLIC SYSTEMS: ANALYTICAL AND NUMERICAL APPROACH Final Report
Fabio Gastaldi and Alfio Quarteroni (Cattolica Univ., Brescia, Italy) Oct. 1988 45 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181727; ICASE-88-55; NAS 1.26:181727) Avail: NTIS HC A03/MF A01 CSCL 20D

The coupling of hyperbolic and parabolic systems is discussed in a domain Omega divided into two distinct subdomains omega(+) and omega(-). The main concern is to find the proper interface conditions to be fulfilled at the surface separating the two domains. Next, they are used in the numerical approximation of the problem. The justification of the interface conditions is based on a singular perturbation analysis, i.e., the hyperbolic system is rendered parabolic by adding a small artifical viscosity. As this goes to zero, the coupled parabolic-parabolic problem degenerates into the original one, yielding some conditions at the interface. These are taken as interface conditions for the hyperbolic-parabolic problem. Actually, two alternative sets of interface conditions are discussed according to whether the regularization procedure is variational or nonvariational. It is shown how these conditions can be used in the frame of a numerical approximation to the given problem. Furthermore, a method of resolution is discussed which alternates the resolution of the hyperbolic problem within omega(-) and of the parabolic one within omega(+). The spectral collocation method is proposed, as an example of space discretization (different methods could be used as well); both explicit and implicit

time-advancing schemes are considered. The present study is a preliminary step toward the analysis of the coupling between Euler and Navier-Stokes equations for compressible flows. Author

N89-13730*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INTERFERENCE EFFECTS ON THE HYPERSONIC, RAREFIED FLOW ABOUT A FLAT PLATE
Richard G. Wilmoth Sep. 1988 38 p
(NASA-TM-100674; NAS 1.15:100674) Avail: NTIS HC A03/MF A01 CSCL 20D

The Direct Simulation Monte Carlo method is used to study the hypersonic, rarified flow interference effects on a flat plate caused by nearby surfaces. Calculations focus on shock-boundary-layer and shock-lip interactions in nypersonic inlets. Results are presented for geometries consisting of a flat plate with different leading-edge shapes over a flat lower wall and a blunt-edge flat plate over a 5-degree wedge. The problems simulated correspond to a typical entry flight condition of 7.5 km/s at altitudes of 75 to 90 km. The results show increases in predicted local heating rates for shock-boundary-layer and shock-lip interactions that are quantitatively similar to those observed experimentally at much higher densities. Author

N89-13731*# Grumman Aerospace Corp., Bethpage, N.Y. Space Systems Div.
SOLAR DYNAMIC HEAT REJECTION TECHNOLOGY. TASK 1: SYSTEM CONCEPT DEVELOPMENT Final Report
Eric Gustafson and Albert W. Carlson Jun. 1987 120 p
(Contract NAS3-24665)
(NASA-CR-179618; NAS 1.26:179618) Avail: NTIS HC A06/MF A01 CSCL 20D

The results are presented of a concept development study of heat rejection systems for Space Station solar dynamic power systems. The heat rejection concepts are based on recent developments in high thermal transport capacity heat pipe radiators. The thermal performance and weights of each of the heat rejection subsystems is addressed in detail, and critical technologies which require development tests and evaluation for successful demonstration are assessed and identified. Baseline and several alternate heat rejection system configurations and optimum designs are developed for both Brayton and Rankine cycles. The thermal performance, mass properties, assembly requirements, reliability, maintenance requirements and life cycle cost are determined for each configuration. A specific design was then selected for each configuration which represents an optimum design for that configuration. The final recommendations of heat rejection system configuration for either the Brayton or Rankine cycles depend on the priorities established for the evaluation criteria. Author

N89-13732*# California Univ., Los Angeles. Dept. of Mathematics.
ESSENTIALLY NON-OSCILLATORY SHOCK CAPTURING METHODS APPLIED TO TURBULENCE AMPLIFICATION IN SHOCK WAVE CALCULATIONS
Stanley Osher and Chi-Wang Shu (Brown Univ., Providence, R. I.) [1988] 9 p Sponsored in part by Defense Advanced Research Projects Agency, Arlington, Va.
(Contract NAG1-270; N00014-86-K-0691; NSF DMS-85-03294; NSF DMS-88-10150)
(NASA-CR-183018; NAS 1.26:183018) Avail: NTIS HC A02/MF A01 CSCL 20D

ENO (essentially non-oscillatory) schemes can provide uniformly high order accuracy right up discontinuities while keeping sharp, essentially non-oscillatory shock transitions. Recently, an efficient implementation of ENO schemes was obtained based on fluxes and TVD Runge-Kutta time discretizations. The resulting code is very simple to program for multi-dimensions. ENO schemes are especially suitable for computing problems with both discontinuities and fine structures in smooth regions, such as shock interaction with turbulence, for which results for 1-D and 2-D Euler equations are presented. Much better resolution is observed by using third order ENO schemes than by using second order TVD schemes for such problems. Author

N89-13733# Grenoble Univ. (France). Inst. de Mecanique.
EXPERIMENTAL INVESTIGATION OF RETARDED UNSTEADY TURBULENT BOUNDARY LAYERS Periodic Report, No. 3, Dec. 1987 - Jun. 1988
G. Binder Jun. 1988 4 p
(Contract DAJA45-87-C-0015)
(AD-A198687; R/D-4922-AN-01) Avail: NTIS HC A02/MF A01 CSCL 14B

The research work has been focused on the response of the turbulent eddy structure near the wall to imposed oscillations. Progress report: (1) the construction of the calibration facility and of the carriage for hot film probes has been finished, (2) the software for the data acquisition system (OLIVETTI M240 micro-computer with ANALOG DEVICE interface) has been written and tested. Data acquisition with a sampling rate up to 10 kHz can be performed. GRA

N89-13734# Yale Univ., New Haven, Conn. Dept. of Computer Science.
POTENTIAL FLOW IN CHANNELS
L. Greengard Jul. 1988 23 p
(Contract N00014-86-K-0310)
(AD-A198706; YALEU/DCS/RR-635) Avail: NTIS HC A03/MF A01 CSCL 20D

A method is presented for calculating potential flows in infinite channels. Given a collection of N sources in the channel and a zero normal flow boundary condition, the method requires an amount of work proportional to N to evaluate the induced velocity field at each source position. Previous schemes have been based either on conformal mapping, which experiences numerical difficulties with the domain boundary, or direct evaluation of the Green's function. Both require O (N-sq) work. A fast algorithm for potential flow in channels has been developed. It is based on asymptotic expansions which we refer to as S-expansions, some analytic observations concerning classical multipole expansions and Taylor series, and the Fast Multipole Method. The asymptotic CPU time requirements for the algorithm grow linearly with the number of sources and, despite its complex structure, numerical experiments demonstrate that dramatic speedups can be obtained for even moderate size particle systems. In its current form, the algorithm requires that the channel boundaries be straight. A method applicable to channels with perturbed boundaries will be described in a subsequent paper. GRA

N89-13735# Naval Ship Research and Development Center, Bethesda, Md.
A POTENTIAL FLOW SOLUTION ON MARINE PROPELLER AND AXIAL ROTATING FAN Final Report
Y. T. Lee, C. W. Jiang, and T. W. Bein Aug. 1988 30 p
(AD-A198781; DTRC-88/031) Avail: NTIS HC A03/MF A01 CSCL 20D

Integral equations are derived to model the solid surfaces and the inlet condition for both external and internal flows with an axially rotating element. Vortex filaments are used to simulate the lifting surfaces. Global iterations for surface-panel source densities and vortex strengths are used in conjunction with the Neumann iterations for solving integral equations. A special kernel treatment is adopted in the solution scheme of the integral equation. Solutions converge within 10 to 20 iterations. Calculated results and measured data for a propeller tested in open water are in good agreement. Predictions are also made for an axial-flow pump. The overall performance parameters for the pump agree within a few percent of the design values. GRA

N89-13736# Illinois Inst. of Tech., Chicago. Fluid Dynamics Research Center.
MANAGEMENT AND CONTROL OF SEPARATION BY UNSTEADY AND VORTICAL FLOWS Final Technical Report, Oct. 1984 - Oct. 1987
Hassan M. Nagib, Mukund Acharya, Patrick H. Reisenthel, John

L. Way, and David R. Williams Jun. 1988 7 p
(Contract F49620-84-C-0080)
(AD-A198902; AFOSR-88-0745TR) Avail: NTIS HC A02/MF A01 CSCL 01A

Management and Control of 2-D and 3-D separated flows by unsteady and/or vortical flows is investigated in a number of configurations aimed at an enhanced basic understanding of governing mechanisms. The investigations are aimed at impacting the design of future generations of aircraft with improved maneuverability for better performance and safety. Also, novel techniques are being developed for the measurement, mapping and documentation of these complex unsteady flowfields. GRA

N89-13737# Los Alamos National Lab., N. Mex.
NONLINEAR STABILITY OF IDEAL FLUID EQUILIBRIA
Darryl D. Holm 1988 67 p Presented at the Enrico Fermi School of Physics on Nonlinear Topics in Ocean Physics Conference, Varenna, Italy, 26 Jun. 1988
(Contract W-7405-eng-36)
(DE88-014477; LA-UR-88-1743; CONF-8806161-2) Avail: NTIS HC A04/MF A01

The Lyapunov method for establishing stability is related to well- known energy principles for nondissipative dynamical systems. A development of the Lyapunov method for Hamiltonian systems due to Arnold establishes sufficient conditions for Lyapunov stability by using the energy plus other conserved quantities, together with second variations and convexity estimates. When treating the stability of ideal fluid dynamics within the Hamiltonian framework, a useful class of these conserved quantities consists of the Casimir functionals, which Poisson-commute with all functionals of the dynamical fluid variables. Such conserved quantities, when added to the energy, help to provide convexity estimates that bound the growth of perturbations. These convexity estimates, in turn, provide norms necessary for establishing Lyapunov stability under the nonlinear evolution. In contrast, the commonly used second variation or spectral stability arguments only prove linearized stability. As ideal fluid examples, in these lectures we discuss planar barotropic compressible fluid dynamics, the 3+D hydrostatic Boussinseq model, and a new set of shallow water equations with nonlinear dispersion. Remarkably, all three of these samples have the same Hamiltonian structure and, thus, possess the same Casimir functionals upon which their stability analyses are based. We also treat stability of modified quasigeostrophic flow, a problem whose Hamiltonian structure and Casimirs closely resemble Arnold's original example. Finally, we discuss some aspects of conditional stability and the applicability of Arnold's development of the Lyapunov technique. DOE

N89-13738# Los Alamos National Lab., N. Mex. Center for Nonlinear Studies.
DIFFUSION IN LATTICE FLUIDS
Philippe Binder 1988 11 p Presented at the Workshop in Discrete Kinetic Theory, Torino, Italy, 20 Sep. 1988
(Contract W-7405-eng-36)
(DE88-016331; LA-UR-88-2654; CONF-8809128-1) Avail: NTIS HC A03/MF A01

Diffusion is the transport of mass caused by molecular motion. In this article we review recent studies of the motion of one tagged particle in: (1) a static, disordered medium, and (2) a bath of moving particles, both in two-dimensional lattices. We find in the first study that diffusion only exists if the particle-scatterer collision rules are nondeterministic. In the second study we find that the two-dimensional diffusion coefficient exists, apparently without a logarithmic divergence. We also find that several tagged-particle collisions rules are consistent with the moving particle rules, leading to the non-uniqueness of the diffusion coefficient. These results are relevant to the study of diffusion in lattice gas automata. DOE

N89-13739# Lawrence Livermore National Lab., Calif.
SHOCK WAVES AS TURBULENT MIX AMPLIFIERS
Alfred C. Buckingham Jun. 1988 9 p Presented at the Nuclear Explosives Code Developer's Conference, Boulder, Colo., 11-14 Oct. 1988
(Contract W-7405-eng-48)
(DE88-012437; UCRL-98890; CONF-881093-1) Avail: NTIS HC A02/MF A01

In our initial studies of the shockwave-turbulence interaction process, we emphasized the apparent enhancement a pre-existing turbulent field induced by shock passage. The present investigations are concerned with the possibly significant changes induced in shock-front structure during interactions with turbulence. The shock front may be diffracted; its initially planar surface may deform into a wrinkled or corrugated pattern; or it may break up into a succession of wavelets. A crucial question is whether or not the shockwave remains a sharp discontinuity albeit randomly wrinkled or corrugated by interaction with random perturbations in density, velocity, and/or pressure associated with the downstream turbulence. An additional question concerns the time of influence exerted by the shockwave in redistribution of turbulence. At some point, the apparent enhancement ceases and the turbulence decays to pre-existing levels. Geometrical distortions at the front alter the mean flow strain pattern influencing the persistence of duration of this shock interaction/turbulent enhancement process after passage of the shock front well downstream of the interaction region. Examination and description of the influence of these alterations to shockwave structure during shock-turbulence interaction are the basic themes of this work. DOE

N89-13740# Integral Technologies, Inc., Westmont, Ill.
MULTIDIMENSIONAL MODELING OF CONVECTIVE HEAT TRANSFER WITH APPLICATION TO I.C. ENGINES Technical Progress Report
Mark J. Jennings and Thomas Morel 15 Jul. 1988 17 p
(Contract DE-AC04-86AL-33183)
(DE88-013010; DOE/AL-33183/T7) Avail: NTIS HC A03/MF A01

The objective of this project is to develop a more comprehensive understanding of the convective heat transfer process in complex, unsteady turbulent reacting flows, typical of those which occur in internal combustion engines. The specific area of research is the representation of heat transfer in detailed multi-dimensional Navier-Stokes models, and modeling of turbulent transport mechanisms. The detailed tasks include a review of relevant prior work. Based on this review, and original work done under this contract, several modeling approaches will be formulated and further studied and tested. The tests will be carried out on flow cases which have relevance to engine flows, and for which reliable experimental data exist. DOE

N89-13741*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A NEAR-WALL TURBULENCE MODEL AND ITS APPLICATION TO FULLY DEVELOPED TURBULENT CHANNEL AND PIPE FLOWS
S.-W. Kim Nov. 1988 31 p
(NASA Order C-99066-G)
(NASA-TM-101399; ICOMP-88-20; E-4483; NAS 1.15:101399)
Avail: NTIS HC A03/MF A01 CSCL 20D

A near wall turbulence model and its incorporation into a multiple-time-scale turbulence model are presented. In the method, the conservation of mass, momentum, and the turbulent kinetic energy equations are integrated up to the wall; and the energy transfer rate and the dissipation rate inside the near wall layer are obtained from algebraic equations. The algebraic equations for the energy transfer rate and the dissipation rate inside the near wall layer were obtained from a k-equation turbulence model and the near wall analysis. A fully developed turbulent channel flow and fully developed turbulent pipe flows were solved using a finite element method to test the predictive capability of the turbulence model. The computational results compared favorably with experimental data. It is also shown that the present turbulence model could resolve the over shoot phenomena of the turbulent kinetic energy and the dissipation rate in the region very close to the wall. Author

N89-13742# International Centre for Theoretical Physics, Trieste (Italy).
SURFACE WAVES
F. Khalil Nov. 1987 19 p Submitted for publication
(DE88-703518; IC-87/376) Avail: NTIS (US Sales Only) HC A03/MF A01

Two-dimensional surface waves including surface tension are considered in this paper. The disturbance potential phi created by a moving concentrated pressure has been determined uniquely following Peters. Linearized free surface conditions have been utilized. The free surface elevations eta(x) have been obtained and discussed for stream velocities U greater than or equal to U sub min, the minimum wave velocity. The results obtained are satisfactory. It is hoped that a similar approach may help to solve the three-dimensional problem. It is, of course, apprehended that it may lead to complications which may not be easy to handle theoretically. DOE

N89-13743# International Centre for Theoretical Physics, Trieste (Italy).
FREE CONVECTION HEAT AND MASS TRANSFER TO STEADY FLOW IN A SEMI-INFINITE VERTICAL POROUS MEDIUM
A. R. Bestman Feb. 1988 11 p
(DE88-703529; IC-88/41) Avail: NTIS (US Sales Only) HC A03/MF A01

Analytical solutions are derived for a flow in a semi-infinite vertical porous medium with heat and mass transfer. When the temperature and mass concentration are uniform a constant pressure is possible and sustains a fully developed flow. Thereafter there is a small perturbation on the wall temperature and concentration and the subsequent two-dimensional problem is tackled for a large Prandtl number, free convection parameters and small Reynolds number. The heat transfer rate at the wall is discussed quantitatively. DOE

N89-13744# International Centre for Theoretical Physics, Trieste (Italy).
ON THE THERMAL STABILITY OF A RADIATING GAS UNDER GENERAL DIFFERENTIAL APPROXIMATION
A. R. Bestman Feb. 1988 13 p Submitted for publication
(DE88-703530; IC-88/42) Avail: NTIS (US Sales Only) HC A03/MF A01

The thermal stability of a radiating gas in a semi-infinite space is studied under a general differential approximation. The fluid is bounded on the axis z'=0 by a horizontal infinite wall maintained at a temperature T sub 0 which is high enough for radiative heat transfer to be significant. At z'=infinity, the fluid is at uniform temperature T sub infinity such that T sub 0 greater than T sub infinity. The equations of motion under small perturbation theory reduce to a set of linear homogeneous equations with a variable coefficient subject to homogeneous boundary conditions when the unperturbed temperature is adopted as the independent variable. The solution is effected via a finite difference scheme and the Rayleigh number is determined by Newton's iterative method. DOE

N89-13745# International Centre for Theoretical Physics, Trieste (Italy).
UNSTEADY FLOW OF AN INCOMPRESSIBLE FLUID IN A HORIZONTAL POROUS MEDIUM WITH SUCTION
A. R. Bestman Apr. 1988 9 p Submitted for publication
(DE88-703537; IC-88/74) Avail: NTIS (US Sales Only) HC A02/MF A01

A theoretical analysis of two-dimensional unsteady flow in a porous medium bounded by a horizontal wall is presented as a perturbation on a basic flow. It is assumed that the perturbation is occasioned by a sudden suction at the wall. Even for a highly permeable medium the characteristic Reynolds number in porous media flow is usually small and asymptotic solutions are developed by the Laplace transform technique. It is observed that the perturbed shear stress at the wall decays exponentially with time. DOE

N89-13746*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL AND ANALYTICAL EVALUATION OF THE TAPERED TENSION-TORSION STRAP CONCEPT
Alexander Louie Nov. 1988 18 p
(NASA-TM-101049; A-88321; NAS 1.15:101049) Avail: NTIS HC A03/MF A01 CSCL 20D

A new free-tip rotor moment controller designed to increase torque output (a restoring moment) was proposed. The controller would be used as a retention device for the freely pitching tip of a helicopter rotor. The new design featured a tapered tension-torsion strap instead of the previously used parellel strap. A tapered strap has a larger separation between the tension wires at the retention end than at the oscillating end; separation is equal at both ends for a parallel strap. A simple dynamic analysis was developed and an experiment performed to evaluate this tapered strap concept. The test results indicated that the torsional spring stiffness of the strap, represented by a torsional pendulum, increased with the amount of taper. The predicted dynamic characteristics of the pendulum also confirmed this observation and correlated reasonably well with the experimental results. It could be concluded from the experimental and analytical results that the tapered strap accomplished increased torque output when compared to the parellel strap. Author

N89-13747*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SURFACE GRID GENERATION FOR COMPLEX THREE-DIMENSIONAL GEOMETRIES
Raymond Ching-Chung Luh Oct. 1988 15 p
(NASA-TM-101046; A-88318; NAS 1.15:101046) Avail: NTIS HC A03/MF A01 CSCL 20D

An outline is presented for the creation of surface grids from primitive geometry data such as obtained from CAD/CAM systems. The general procedure is applicable to any geometry including full aircraft with wing, nacelle, and empennage. When developed in an interactive graphics environment, a code based on this procedure is expected to substantially improve the turn around time for generating surface grids on complex geometries. Results are shown for a general hypersonic airplane geometry. Author

N89-13748# Lawrence Livermore National Lab., Calif.
A CENTERED ARTIFICIAL VISCOSITY FOR CELLS WITH LARGE ASPECT RATIO
L. G. Margolin 15 Aug. 1988 29 p
(Contract W-7405-eng-48)
(DE89-000604; UCRL-53882) Avail: NTIS HC A03/MF A01

The author has developed a new artificial viscosity for numerical fluid dynamics codes in two dimensions. The formulation combines the advantages of cell-centered treatment with the ability of the edge-centered method to handle cells with large aspect ratio. This report describes the derivation of the new viscosity, whose magnitude and tensor properties both differ from standard treatments. The new viscosity has been implemented in the SHALE code. Calculations on two variations of a test problem representing a shock propagating obliquely through a two-dimensional mesh are presented. DOE

N89-13749*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AXISYMMETRIC CONFINED TURBULENT JET DIRECTED TOWARDS THE LIQUID SURFACE FROM BELOW
Mohammad M. Hasan and Chin-Shun Lin (Analex Corp., Cleveland, Ohio.) [1988] 11 p Presented at the 27th Aerospace Sciences Meeting, Reno, Nev., 9-12 Jan. 1989; sponsored by AIAA
(NASA-TM-101409; E-4499; NAS 1.15:101409; AIAA-89-0172)
Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical simulation is presented of an axisymmetric turbulent jet discharging axially from below into a cylindrical tank and directed towards the liquid vapor interface. The liquid vapor interface is assumed to be flat and shear free. The k-epsilon turbulence model is used to calculate the eddy viscosity. The turbulence intensity distribution and the length scale associated with the k-epsilon

model are calculated as functions of jet flow rates and systems parameters. Numerical results are compared with appropriate experimental data. The problems associated with the free surface boundary conditions for the turbulent quantities are discussed.
Author

N89-13750# North Carolina State Univ., Raleigh.
NONLINEAR ERROR ANALYSIS OF FINITE DIFFERENCE SOLUTIONS OF TURBULENT AND UNSTEADY FLOW FIELDS Final Report, Apr. 1983 - Sep. 1986
D. Scott McRae and Goetz H. Klopfer (Nielsen Engineering and Research, Inc., Mountain View, Calif.) 23 May 1988 248 p
(Contract F33615-83-C-3029)
(AD-A198011; NEAR-TR-379; AFWAL-TR-88-3012) Avail: NTIS HC A11/MF A01 CSCL 20D

A computational analysis is performed for the truncation errors incurred in the numerical time integration of the unsteady and/or turbulent Navier-Stokes equations. The means of analysis is via the modified equation approach. Both the MacCormack explicit and Beam-Warming implicit numerical methods are considered. A simplified analysis applied to Burger's equation indicates that the leading order term is both dissipative and dispersive. The modified equation is derived for the aforementioned explicit and implicit methods as applied to the full two-dimensional Navier-Stokes equations. Development of the required FORTRAN code for solution of the modified equation is expedited through the use of the symbolic manipulation language, MACSYMA. GRA

N89-13751# Illinois Inst. of Tech., Chicago. Fluid Dynamics Research Center.
MANAGEMENT AND CONTROL OF UNSTEADY AND TURBULENT FLOWS Annual Technical Report, Oct. 1986 - Oct. 1987
Hassan M. Nagib, Mukund Acharya, Thomas C. Corke, Patrick H. Reisenthel, and Candace E. Wark Jun. 1988 15 p
(Contract F49620-86-C-0133)
(AD-A198091; AFOSR-88-0747TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Progress in four areas of research has been achieved during the first year: (1) controlled transitioning boundary layers; phase coupled plane TS waves and oblique waves are used to study various types of transition including detuned modes, (2) turbulent boundary layer structure and control; the structures responsible for the turbulence production in high Reynolds number boundary layers have been documented and manipulated, (3) management of unsteady and three-dimensional flows; flows over airfoils, axisymmetric forebodies, vortex-wing interactions, and wing-body junctions, are examined with and without passive and active flow manipulators including zero-mass base bleed, (4) scanning laser anemometry; a technique capable of mapping the flowfield in a plane has been developed. GRA

N89-13752*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ALGEBRAIC TURBULENCE MODELS FOR THE COMPUTATION OF TWO-DIMENSIONAL HIGH SPEED FLOWS USING UNSTRUCTURED GRIDS Final Report
Philippe Rostand (Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay, France) Nov. 1988 44 p Submitted for publication
(Contracts NAS1-18107; NAS1-18605; DRET-03407901)
(NASA-CR-181741; ICASE-88-63; NAS 1.26:181741) Avail: NTIS HC A03/MF A01 CSCL 20D

The incorporation of algebraic turbulence models in a solver for the 2-D compressible Navier-Stokes equations using triangular grids is described. A practical way to use the Cebeci Smith model, and to modify it in separated regions is proposed. The ability of the model to predict high speed, perfect gas boundary layers is investigated from a numerical point of view. Author

N89-13753*# Stanford Univ., Calif.
CONTRACTION DESIGN FOR SMALL LOW-SPEED WIND TUNNELS
James H. Bell and Rabindra D. Mehta Aug. 1988 39 p
(Contract NCC2-294)
(NASA-CR-177488; NAS 1.26:177488) Avail: NTIS HC A03/MF A01 CSCL 20D

An iterative design procedure was developed for two- or three-dimensional contractions installed on small, low-speed wind tunnels. The procedure consists of first computing the potential flow field and hence the pressure distributions along the walls of a contraction of given size and shape using a three-dimensional numerical panel method. The pressure or velocity distributions are then fed into two-dimensional boundary layer codes to predict the behavior of the boundary layers along the walls. For small, low-speed contractions it is shown that the assumption of a laminar boundary layer originating from stagnation conditions at the contraction entry and remaining laminar throughout passage through the successful designs if justified. This hypothesis was confirmed by comparing the predicted boundary layer data at the contraction exit with measured data in existing wind tunnels. The measured boundary layer momentum thicknesses at the exit of four existing contractions, two of which were 3-D, were found to lie within 10 percent of the predicted values, with the predicted values generally lower. From the contraction wall shapes investigated, the one based on a fifth-order polynomial was selected for installation on a newly designed mixing layer wind tunnel.
Author

N89-13754*# General Motors Corp., Indianapolis, Ind. Allison Gas Turbine Div.
THE EFFECTS OF LEADING EDGE AND DOWNSTREAM FILM COOLING ON TURBINE VANE HEAT TRANSFER Final Report
L. D. Hylton, V. Nirmalan, B. K. Sultanian, and R. M. Kaufman Nov. 1988 175 p
(Contract NAS3-24619)
(NASA-CR-182133; NAS 1.26:182133; Allison-EDR-13481) Avail: NTIS HC A08/MF A01 CSCL 20D

The progress under contract NAS3-24619 toward the goal of establishing a relevant data base for use in improving the predictive design capabilities for external heat transfer to turbine vanes, including the effect of downstream film cooling with and without leading edge showerhead film cooling. Experimental measurements were made in a two-dimensional cascade previously used to obtain vane surface heat transfer distributions on nonfilm cooled airfoils under contract NAS3-22761 and leading edge showerhead film cooled airfoils under contract NAS3-23695. The principal independent parameters (Mach number, Reynolds number, turbulence, wall-to-gas temperature ratio, coolant-to-gas temperature ratio, and coolant-to-gas pressure ratio) were maintained over ranges consistent with actual engine conditions and the test matrix was structured to provide an assessment of the independent influence of parameters of interest, namely, exit Mach number, exit Reynolds number, coolant-to-gas temperature ratio, and coolant-to-gas pressure ratio. Data provide a data base for downstream film cooled turbine vanes and extends the data bases generated in the two previous studies. The vane external heat transfer obtained indicate that considerable cooling benefits can be achieved by utilizing downstream film cooling. The data obtained and presented illustrate the interaction of the variables and should provide the airfoil designer and computational analyst the information required to improve heat transfer design capabilities for film cooled turbine airfoils. Author

N89-13755*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
LDV MEASUREMENTS IN AN ANNULAR COMBUSTOR MODEL M.S. Thesis
Dean A. Barron Aug. 1986 161 p
(Contract NAS3-24350)
(NASA-CR-182207; NAS 1.26:182207; Purdue-MS-34971) Avail: NTIS HC A08/MF A01 CSCL 20D

The design and setup of a Laser Doppler Velocimeter (LDV) system used to take velocity measurements in an annular combustor model are covered. The annular combustor model is of contemporary design using 60 degree flat vane swirlers,

producing a strong recirculation zone. Detailed measurements are taken of the swirler inlet air flow and of the downstream enclosed swirling flow. The laser system used is a two color, two component system set up in forward scatter. Detailed are some of the special considerations needed for LDV use in the confined turbulent flow of the combustor model. The LDV measurements in a single swirler rig indicated that the flow changes radically in the first duct height. After this, a flow profile is set up and remains constant in shape. The magnitude of the velocities gradually decays due to viscous damping. Author

N89-13756*# United Technologies Research Center, East Hartford, Conn.
THE EFFECTS OF INLET TURBULENCE AND ROTOR/STATOR INTERACTIONS ON THE AERODYNAMICS AND HEAT TRANSFER OF A LARGE-SCALE ROTATING TURBINE MODEL, VOLUME 1 Final Report
R. P. Dring, M. F. Blair, H. D. Joslyn, G. D. Power, and J. M. Verdon · Washington, D.C. Jul. 1987 173 p
(Contract NAS3-23717)
(NASA-CR-4079; E-3536; NAS 1.26:4079; UTRC-R86-956480-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 20D

A combined experimental and analytical program was conducted to examine the effects of inlet turbulence on airfoil heat transfer. Heat transfer measurements were obtained using low conductivity airfoils with miniature thermocouples welded to a thin, electrically heated surface skin. Heat transfer data were acquired for various combinations of low or high inlet turbulence intensity, flow coefficient (incidence), first-stator/rotor axial spacing, Reynolds number, and relative circumferential position of the first and second stators. Aerodynamic measurements include distributions of the mean and fluctuating velocities at the turbine inlet and, for each airfoil row, midspan airfoil surface pressures and circumferential distributions of the downstream steady state pressures and fluctuating velocities. Analytical results include airfoil heat transfer predictions and a examination of solutions of the unstead boundary layer equipment. Author

N89-13757*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THREE-DIMENSIONAL MARGINAL SEPARATION
Peter W. Duck Dec. 1988 33 p
(SAA-C99066G)
(NASA-TM-101411; E-4503; NAS 1.15:101411; ICOMP-88-22)
Avail: NTIS HC A03/MF A01 CSCL 20D

The three dimensional marginal separation of a boundary layer along a line of symmetry is considered. The key equation governing the displacement function is derived, and found to be a nonlinear integral equation in two space variables. This is solved iteratively using a pseudo-spectral approach, based partly in double Fourier space, and partly in physical space. Qualitatively, the results are similar to previously reported two dimensional results (which are also computed to test the accuracy of the numerical scheme); however quantitatively the three dimensional results are much different. Author

N89-13758*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.
SSME LOX POST FLOW ANALYSES/FLUID STRUCTURE INTERACTION Final Report
20 Sep. 1988 25 p
(Contract NAS8-35505)
(NASA-CR-183538; NAS 1.26:183538; LMSC-HEC-TR-F226055)
Avail: NTIS HC A03/MF A01 CSCL 20D

Test firings of the Space Shuttle Main Engine (SSME) over the course of its development have resulted in several catastrophic failures. Some of these failures were due to breakage of the LOX posts that feed liquid oxygen into the main injector head of the engine. The objective was to perform a computational fluid flow analysis of a simplified SSME LOX post array using an existing viscous Navier-Stokes flow solver. A two-dimensional analysis was to be made. In addition, a finite element theory for treating the fluid/structure interaction between the posts and the hot gas environment was to be developed. The methodology used in computing the flow field through the LOX post array is described. Results are presented and discussed. Author

N89-13759*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RAREFIED FLOW PAST A FLAT PLATE AT INCIDENCE
Virendra K. Dogra (Vigyan Research Associates, Inc., Hampton, Va.), James N. Moss, and Joseph M. Price Sep. 1988 31 p Presented at the 16th International Symposium on Rarefied Gas Dynamics, Pasadena, Calif., 10-16 Jul. 1988 Submitted for publication
(NASA-TM-101493; NAS 1.15:101493) Avail: NTIS HC A03/MF A01 CSCL 20D

Results of a numerical study using the direct simulation Monte Carlo (DSMC) method are presented for the transitional flow about a flat plate at 40 deg incidence. The plate has zero thickness and a length of 1.0 m. The flow conditions simulated are those experienced by the Shuttle Orbiter during reentry at 7.5 km/s. The range of freestream conditions are such that the freestream Knudsen number values are between 0.02 and 8.4, i.e., conditions that encompass most of the transitional flow regime. The DSMC simulations show that transitional effects are evident when compared with free molecule results for all cases considered. The calculated results demonstrate clearly the necessity of having a means of identifying the effects of transitional flow when making aerodynamic flight measurements as are currently being made with the Space Shuttle Orbiter vehicles. Previous flight data analyses have relied exclusively on adjustments in the gas-surface interaction models without accounting for the transitional effect which can be comparable in magnitude. The present calculations show that the transitional effect at 175 km would increase the Space Shuttle Orbiter lift-drag ratio by 90 percent over the free molecule value. Author

N89-13760*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
FLOWMETER EVALUATION FOR ON-ORBIT OPERATIONS
R. S. Baird Aug. 1988 141 p
(NASA-TM-100465; S-578; NAS 1.15:100465) Avail: NTIS HC A07/MF A01 CSCL 20D

Various flowmetering concepts were flow tested to characterize the relative capabilities and limitations for on-orbit fluid-transfer operations. Performance results and basic operating principles of each flowmetering concept tested are summarized, and basic considerations required to select the best flowmeter(s) for fluid system application are discussed. Concepts tested were clamp-on ultrasonic, area averaging ultrasonic, offset ultrasonic, coriolis mass, vortex shedding, universal venturi tube, turbine, bearingless turbine, turbine/turbine differential-pressure hybrid, dragbody, and dragbody/turbine hybrid flowmeters. Fluid system flowmeter selection considerations discussed are flowmeter performance, fluid operating conditions, systems operating environments, flowmeter packaging, flowmeter maintenance, and flowmeter technology. No one flowmetering concept tested was shown to be best for all on-orbit fluid systems. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N89-13761*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PARTICLE ASTROPHYSICS MAGNET FACILITY: ASTROMAG Interim Report, Aug. 1986

Jonathan F. Ormes, ed., Martin H. Israel, ed., Richard A. Mewaldt, ed., and Mark E. Wiedenbeck, ed. (Chicago Univ., Ill.) May 1988 87 p
(NASA-TM-101250; NAS 1.15:101250) Avail: NTIS HC A05/MF A01 CSCL 14B

The primary scientific objectives of ASTROMAG are to: examine cosmological models by searching for antimatter and dark matter candidates; study the origin and evolution of matter in the galaxy by direct sampling of galactic matter; and study the origin and acceleration of the relativistic particle plasma in the galaxy and its effects on the dynamics and evolution of the galaxy. These general scientific objectives will be met by ASTROMAG with particle detection instruments designed to make the following observations: search, for anti-nuclei of helium and heavier element; measure the spectra of anti-protons and positrons; measure the isotopic composition of cosmic ray nuclei at energies of several GeV/amu; and measure the energy spectra of cosmic ray nuclei to very high energies. Author

N89-13762*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPATIAL VISION PROCESSES: FROM THE OPTICAL IMAGE TO THE SYMBOLIC STRUCTURES OF CONTOUR INFORMATION
Daniel J. Jobson Nov. 1988 31 p Original contains color illustrations
(NASA-TP-2838; L-16479; NAS 1.60:2838) Avail: NTIS HC A03/MF A01 CSCL 14B

The significance of machine and natural vision is discussed together with the need for a general approach to image acquisition and processing aimed at recognition. An exploratory scheme is proposed which encompasses the definition of spatial primitives, intrinsic image properties and sampling, 2-D edge detection at the smallest scale, the construction of spatial primitives from edges, and the isolation of contour information from textural information. Concepts drawn from or suggested by natural vision at both perceptual and physiological levels are relied upon heavily to guide the development of the overall scheme. The scheme is intended to provide a larger context in which to place the emerging technology of detector array focal-plane processors. The approach differs from many recent efforts in edge detection and image coding by emphasizing smallest scale edge detection as a foundation for multi-scale symbolic processing while diminishing somewhat the importance of image convolutions with multi-scale edge operators. Cursory treatments of information theory illustrate that the direct application of this theory to structural information in images could not be realized. Author

N89-13763*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THREADED AVERAGE TEMPERATURE THERMOCOUPLE Patent Application
Stanley W. Ward, inventor (to NASA) 15 Sep. 1988 8 p
(NASA-Case-LAR-13475-1; NAS 1.71:LAR-13475-1; US-Patent-Appl-SN-244376) Avail: NTIS HC A02/MF A01 CSCL 14B

A threaded average temperature thermocouple is provided to measure the average temperature of a situs in a test material. A ceramic insulator rod with two parallel holes through its length is securely fitted in a cylinder, which is bored along the longitudinal axis of symmetry of a threaded bolt. This threaded bolt is composed of material having thermal properties similar to those of the test material. Leads of a thermocouple wire leading from a remotely situated temperature sensing device are each fed through one of the holes secured at the head end of the ceramic insulator rod, and exit at its tip end. Each lead of the thermocouple is bent into and secured in an opposite radial groove in the tip end of the threaded bolt. The resulting threaded average temperature thermocouple is ready to be inserted into a cylindrical receptacle. The tip end of the threaded average temperature thermocouple is in intimate contact with its receptacle. A jam nut secures the threaded average temperature thermocouple to the test material. NASA

N89-13764*# National Aeronautics and Space Administration. Pasadena Office, Calif.
REMOTE OBJECT CONFIGURATION/ORIENTATION DETERMINATION Patent Application
Larry L. Schumacher, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 29 Aug. 1988 12 p
(Contract NAS7-918)
(NASA-Case-NPO-17436-1-CU; NAS 1.71:NPO-17436-1-CU; US-Patent-Appl-SN-237035) Avail: NTIS HC A03/MF A01 CSCL 14B

This invention relates to object detection and location systems and, more particularly, to a method for determining the configuration and location of an object with respect to an X, Y, X coordinate frame. In space applications in particular, there is a need to be able to passively determine the orientation of an object at a distance, for example, in the control of large, flexible space structures. At present, there is no available method or apparatus which will allow the operator to make such a determination. A similar problem and need exists in robotic application. It is the primary object of this invention to provide a system for remotely defining an object's configuration in a manner compatible with a computer's analytical capability. NASA

N89-13765# Naval Research Lab., Washington, D.C.
DEVELOPMENT OF QUASI-OPTICAL GYROTRONS FOR FUSION PLASMA HEATING
Wallace M. Manheimer, Arne W. Fliflet, John Burke, and Tom Hargreaves 11 Jul. 1988 186 p
(AD-A198786; NRL-MR-6165) Avail: NTIS HC A09/MF A01 CSCL 20I

This memo documents the proposed research program on quasi-optical gyrotrons. The goal would be the design of a 1 to 2 MW CW source at 280 GHz to be built by industry for the purpose of heating such fusion reactors as CIT and ETR. These sources would be tunable to 30 percent by magnetic field and by a few percent by voltage. A prototype at slightly lower frequency would be constructed and this device would be experimentally characterized. The initial program would last for four years and would investigate physics issues at both the cyclotron frequency and its harmonic. A follow on program lasting one to two years would design a 1 MW CW tube at 560 GHz, and experimentally characterize such a megawatt tube at slightly lower frequency. These sources could be utilized for heating such tokamaks as CIT and ETR. At an intermediate stage, a source would be developed for heating Alcator C Mod at a frequency of 240 GHz. The overall program goal is to advance the state of the art of QOG's from the proof-of-principle level to an industrially relevant RF source technology. GRA

N89-13766# Johns Hopkins Univ., Baltimore, Md. Dept. of Materials Science and Engineering.
FULL FIELD VISUALIZATION OF SURFACE AND BULK ACOUSTIC WAVES USING HETERODYNE HOLOGRAPHIC INTERFEROMETRY Annual Summary Report, 1 Oct. 1987 - 30 Sep. 1988
James W. Wagner and Robert E. Green, Jr. 15 Sep. 1988 13 p
(Contract N00014-82-K-0741)
(AD-A199018) Avail: NTIS HC A03/MF A01 CSCL 20F

The objective of this research has been to apply optical holographic techniques coupled with electronic signal and image processing to provide quantitative, full field measurements of acoustic wave disturbances. Building on work performed previously at Johns Hopkins and in its second year under the current contract to the Office of Naval Research, this program has sought to establish the limits of sensitivity with which surface acoustic waves might be measured and mapped. Toward this end, the effects of film resolution on overall sensitivity have been examined. Also, significant efforts have taken place to extend heterodyne holographic measurements to the examination of acoustic energy flow in optically transparent bulk materials. GRA

N89-13767# Oak Ridge Y-12 Plant, Tenn. Physical and Electrical Standards Lab.
A DRIFT-COMPENSATING PRECISION DIVIDER TECHNIQUE USING CIRCULAR DATA PATTERNS
Ross Endsley 21 Sep. 1987 11 p Presented at the IEEE Instrumentation and Measurement Technology Conference, San Diego, Calif., 20 Apr. 1988
(Contract DE-AC05-84OS-21400)
(DE88-012770; Y/IB-6; CONF-880425-2) Avail: NTIS HC A03/MF A01

A divider is described which is able to provide precision integer-to-one ratios (or those ratios nearby). The technique for using the divider compensates for most of the drift associated with resistive dividers. Data acquisition and reduction are based on flexible circular data patterns. An application of the divider is described where it is used to establish the relationship between 10-volt solid-state standards and 1.018-volt saturated standard cells. Comments are included on the repeatability and accuracy obtained with the divider. DOE

N89-13768# EG and G Energy Measurements, Inc., Los Alamos, N. Mex.
MACH-ZEHNDER INTERFEROMETER-BASED RECORDING SYSTEM FOR WACO
R. Woerner Jun. 1988 11 p
(Contract DE-AC08-88NV-10617)
(DE88-013027; EGG-10617-5005) Avail: NTIS HC A03/MF A01

EG and G Energy Measurements, Inc., Los Alamos Operations (LAO) designed and built a Mach-Zehnder-interferometer-based recording system to record low-bandwidth pulses. This work was undertaken at the request of the Los Alamos National Laboratory, P-14 Fast Transient Plasma Measurement group. The system was fielded on WACO and its performance compared with that of a conventional recording system fielded on the same event. The results of the fielding showed that for low bandwidth applications like the WACO experiment, the M-Z-based system provides the same data quality and dynamic range as the conventional oscilloscope system, but it is far less complex and uses fewer recorders. DOE

N89-13769# Aeronautical Research Labs., Melbourne (Australia).
EVALUATION OF A HAND-HELD FRICTIONAL STRAIN GAUGE
M. G. Stimson and J. G. Sparrow Dec. 1987 26 p
(AD-A198125; ARL-STRUC-TM-476; DODA-AR-004-569) Avail: NTIS HC A03/MF A01 CSCL 14B

The Aeronautical Research Laboratories (ARL) Structures Division has acquired a commercially available instrument for obtaining strain values from a cyclically loaded flat surface. This strain gauge has the advantage over a conventional bonded gauge in that it can be applied with little or no preparation time. This advantage makes it useful in conjunction with the SPATE 8000 thermal stress pattern imager which is usually calibrated by obtaining a cyclic strain reading from within the field of view of the article under test. Use of a conventional bonded gauge on the article necessarily obscures some area within the field of view. Experiments were performed to show that an electrical signal linearly dependent on the strain amplitude could be obtained. The accuracy and repeatability of this signal was checked for different frequencies and effects of surface cleanliness. GRA

N89-13770# Florida Univ., Gainesville. Astronomy Lab.
SHUTTLE FLIGHT TEST OF AN ADVANCED GAMMA-RAY DETECTION SYSTEM Final Report, 1 Jul. 1983 - 31 Jul. 1987
Alfred C. Rester, Jr. 30 Jun. 1988 17 p
(Contract F49620-83-C-0131; ARPA Order 4565; AF Proj. 2309)
(AD-A198399; AFOSR-88-0932TR) Avail: NTIS HC A03/MF A01 CSCL 14B

The Gamma-Ray Advanced Detector (GRAD) is a gamma-ray detector system consisting of a large-volume, n-type germanium detector with active shielding of bismuth germanate and plastic scintillators. It was diverted from the AFP-675 program to a balloon flight over Antarctica following the Challenger Disaster and the discovery the following year of the supernova 1987A. The present report outlines activities leading to and following the decision to go to Antarctica and summarizes the basic technological results from the project. GRA

N89-13771*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
FURTHER DEVELOPMENT OF THE DYNAMIC GAS TEMPERATURE MEASUREMENT SYSTEM. VOLUME 2: COMPUTER PROGRAM USER'S MANUAL Final Report
Dana R. Stocks Aug. 1986 141 p
(Contract NAS3-24228)
(NASA-CR-179604; NAS 1.26:179604; P/W/GPD-FR-19381-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 14B

The Dynamic Gas Temperature Measurement System compensation software accepts digitized data from two different diameter thermocouples and computes a compensated frequency response spectrum for one of the thermocouples. Detailed discussions of the physical system, analytical model, and computer software are presented in this volume and in Volume 1 of this report under Task 3. Computer program software restrictions and test cases are also presented. Compensated and uncompensated data may be presented in either the time or frequency domain. Time domain data are presented as instantaneous temperature vs time. Frequency domain data may be presented in several forms such as power spectral density vs frequency. Author

N89-14160*# Puerto Rico Univ., San Juan. Coll. of Engineering.
CHARACTERIZATION OF A TURBOMOLECULAR-PUMPED MAGNETIC SECTOR MASS SPECTROMETER
Narinder K. Mehta *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 130-178 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N89-13772*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
PROOF OF CONCEPT MODEL SEMICONDUCTOR LASER POWER SUMMING SYSTEM (PHASE B): FABRICATION AND TEST OF POC UNITS Final Report, Jun. 1985 - Jun. 1986
James Terrence Ganley and Robert James Smith 18 Jun. 1986 139 p
(Contract NAS5-29148)
(NASA-CR-183408; NAS 1.26:183408) Avail: NTIS HC A07/MF A01 CSCL 20E

Utilization of semiconductor laser diodes as transmitters in spaceborne applications requires increased power levels in a single diffraction limited beam. The design, fabrication, assembly and test of two Proof of Concept dichroic beam combining systems is documented. These systems efficiently combine the beams from seven individual laser diodes into a single beam of high optical quality. Author

N89-13773*# Old Dominion Univ., Norfolk, Va. Dept. of Geological Sciences.
THEORY AND OPERATION OF THE REAL-TIME DATA ACQUISITION SYSTEM FOR THE NASA-LaRC DIFFERENTIAL ABSORPTION LIDAR (DIAL) Final Report, 1 Jan. 1986 - 31 Dec. 1987
Carolyn Butler and Randall Spencer Jan. 1988 65 p
(Contracts NAS1-17993; F33615-86-C-3230)

(NASA-CR-182383; NAS 1.26:182383; GSTR-88-1) Avail: NTIS HC A04/MF A01 CSCL 20E

The improvement of computer hardware and software of the NASA Multipurpose Differential Absorption Lidar (DIAL) system is documented. The NASA DIAL system has undergone development and experimental deployment at NASA/Langley Res. Center for the remote measurement of atmospheric trace gas concentrations from ground and aircraft platforms. A viable DIAL system was developed capable of remotely measuring O3 and H2O concentrations from an aircraft platform. The DIAL Data Acquisition System (DAS) has undergone a number of improvements also. Due to the participation of the DIAL in the Global Tropospheric Experiment, modifications and improvements of the system were tested and used both in the lab and in air. Therefore, this is an operational manual for the DIAL DAS. Author

N89-13774# Utah Univ., Salt Lake City. Dept. of Chemistry.
LOW FREQUENCY LASER DEBYE-SEARS ULTRASONIC MEASUREMENTS Technical Report No. 4, Sep. 1987 - Jun. 1988
G. R. Phillips, C. N. Merrow, J. K. Mitchell, R. M. Barton, and E. M. Eyring 30 Jun. 1988 13 p Submitted for publication
(Contract N00014-86-K-0639)
(AD-A197165) Avail: NTIS HC A03/MF A01 CSCL 20E

The frequency range accessible to the laser Debye Sears technique has been extended downward to 7 MHz. Modifications include a 1 MHz piezoelectric transducer, a 5 mW HeNe probe laser, and an extended optical path. The precision is experimentally characterized using the complexation of NaCl and 18-Crown-6 in H2O. The accessibility of lower frequencies permits the detection of a previously unobserved second relaxation. GRA

N89-13775# Physical Sciences, Inc., Andover, Mass.
CHEMICAL PUMP SOURCES FOR IF(B) Final Report, 1 Mar. 1986 - 4 May 1987
Steven J. Davis, Anne M. Woodward, Lawrence G. Piper, and William J. Marinelli Jun. 1988 91 p
(Contract F29601-86-C-0017)
(AD-A198843; PSI-2000/TR-689; AFWL-TR-87-92) Avail: NTIS HC A05/MF A01 CSCL 20E

Excitation of iodine monofluoride (X) by singlet molecular oxygen was studied. Mechanistic investigations revealed that two excitation routes are active, and both require an intermediate state which is most likely iodine monofluoride. The two models hypothesized and tested are described by: (1) iodine monofluoride reacts with singlet sigma oxygen producing the IF(A) state, this state reacts with singlet delta oxygen producing IF(B), (2) vibrationally hot iodine monofluoride reacts with singlet sigma oxygen to produce the IF(A) this reacts with singlet sigma oxygen and produces IF(B). GRA

N89-13776# Baylor Univ., Dallas, Tex. Research Foundation.
BIOMEDICAL FREE ELECTRON LASER STUDIES Annual Report, 1987 - 1988
J. L. Matthews 1988 110 p
(Contract N00014-86-K-0186)
(AD-A199122) Avail: NTIS HC A06/MF A01 CSCL 09C

Topics addressed include: Photosensitizing dyes for the removal of infectious agents from blood; Intracellular parasite-fluorescent probe interaction; Fluorescence and phosphorescence spectroscopic studies of thin filament proteins; Spectroscopic characterization of six new novel fluorescent probes; Laser spectroscopic studies of protein structure and flexibility; Near-ultraviolet effects on cellular tissue components: Direct photoinduced changes of proteins; Current state of leukemia and autologous bone marrow purging; and Optical properties of biological materials. GRA

N89-13777# Oak Ridge National Lab., Tenn. Analytical Chemistry Div.
INFLUENCE OF LASER CHARACTERISTICS ON RESONANCE IONIZATION MASS SPECTROMETRY
J. P. Young, R. W. Shaw, D. E. Goeringer, and D. H. Smith 1988 5 p Presented at the 4th International Symposium on Resonance Ionization Spectroscopy and its Applications, Gaithersburg, Md., 10 Apr. 1988
(Contract DE-AC05-84OR-21400)
(DE88-008379; CONF-880435-5) Avail: NTIS HC A02/MF A01

Differences are observed among investigators for similar elements studied by resonance ionization mass spectrometry (RIMS). The differences include wavelengths of RIMS transitions, atom sensitivity, and isotope ratio bias measurements. A comparative RIMS study of several 1+1+1 ionization routes for neodymium in the 5800 to 6200 A spectral region using flashlamp, copper vapor laser, and Nd:YAG laser pumped dye lasers is reported here. The lasers chosen have inherent differences in lasing characteristics, such as mode structure, pulse length, peak power and pulse frequency. DOE

N89-13778# Montana State Univ., Bozeman. Dept. of Mechanical Engineering.
LONGITUDINAL WAVE PRECURSOR SIGNAL FROM AN OPTICALLY PENETRATING THERMOELASTIC LASER SOURCE
R. J. Conant and K. L. Telschow (Idaho National Engineering Lab., Idaho Falls.) 1988 9 p Presented at the Review of Progress in Quantitative Nondestructive Evaluation, La Jolla, Calif., 31 Jul. 1988 Submitted for publication
(Contract DE-AC07-76ID-01570)
(DE88-016950; EGG-M-88130; CONF-880760-2) Avail: NTIS HC A02/MF A01

The thermoelastic laser ultrasonic source depends on the optical absorption of energy at the sample surface to produce a volumetric expansion. This paper presents the results of calculations and measurements on the effects of optical penetration of the laser beam into the sample and the elastic waveforms produced. A central result is prediction of a sharp longitudinal waveform that precedes the main waveform and is very similar to that observed with an ablative source (normal point force). The shape of this precursor signal is strongly dependent on the optical penetration depth of the material. A basic explanation of the origin of the precursor signal is given in terms of a one-dimensional model using point sources imbedded within the material. Experimental measurements on a material with a substantial optical penetration depth directly confirm calculations using 2-D integral transform techniques by taking into account the temperature variation with depth. DOE

N89-13779# San Diego State Univ., Calif.
LASER DYE SYNTHESIS: GROUP F COMPOUNDS Final Report, Mar. - Jul. 1987
E. J. Grubbs Feb. 1988 11 p
(Contract N66001-85-D-0203; RR01301)
(AD-A198076; NOSC/TD-1241) Avail: NTIS HC A03/MF A01 CSCL 11C

This report describes progress toward the syntheses of new potential laser dyes. It is anticipated that new substrates will allow upscaling of flashlamp-pumped dye lasers to higher energies. The criteria for assessment of these dyes include: (1) the extent to which they show a lower, laser action threshold, (2) their operational efficiencies, and (3) their photochemical stabilities compared with laser dyes previously evaluated. In principle, high optical quality and convenient cooling are obtainable using a flow system. Also, costs should be relatively small compared with those for solid state lasers if reasonably short, high yield synthetic routes can be found. Pavlopoulos has proposed that improvements in presently available laser dyes may be realized by restricting chromophores and auxochromic groups to coplanarity or near coplanarity. The desired result of imposing these structural conditions is the reduction of intersystem crossing and thus improvements in quantum fluorescence yields. The targeted compounds described were designed to meet these objectives. GRA

N89-13780# San Diego State Univ., Calif.
LASER DYE SYNTHESIS - GROUP C COMPOUNDS Final Report
E. J. Grubbs Jan. 1988 11 p

(Contract N66001-85-D-0203)
(AD-A198187; NOSC/TD-1220) Avail: NTIS HC A03/MF A01 CSCL 11C

Progress on the syntheses of a number of new potential laser dyes is described. The goal is to generate new structures allowing the upscaling of flashlamp pumped dye lasers to high energies. These systems ideally should show a lower laser action threshold, operate with high efficiencies, and exhibit greater photochemical stabilities than do those presently available. Pavlopoulos has proposed: (1) that the parent aromatic chromophores be substituted by auxochromic groups such as hydroxy, alkoxy, and dialkylamino, and (2) that improvement should result by restricting the chromophore and auxochromic group to coplanarity. This should reduce intersystem crossing and thus improve the quantum fluorescence yield. The potential dye lasers described below are designed to meet these objectives. GRA

N89-13781# Los Alamos National Lab., N. Mex. Chemical and Laser Sciences Div.
SYNTHESIS OF MATERIALS WITH INFRARED AND ULTRAVIOLET LASERS
John L. Lyman 1988 29 p Presented at the Conference on Trends in Quantum Electronics, Bucharest, Romania, 29 Aug. 1988
(Contract W-7405-eng-36)
(DE88-016234; LA-UR-88-2740; CONF-8808113-1) Avail: NTIS HC A03/MF A01

This paper discusses three divergent examples of synthesis of materials with lasers. The three techniques are: (1) infrared (CO_2) laser synthesis of silane (SiH_4) from disilane (Si_2H_6); (2) excimer (ArF) laser production of fine silicon powders from methly- and chloro-substituted silanes; and (3) exciver (KrF) laser production of fine metallic powders by laser ablation. The mechanism for each process is discussed along with some conclusions about the features of the laser radiation that enable each application. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N89-13782 Council for National Academic Awards (England).
A FINITE ELEMENT STUDY OF THE STRESS DISTRIBUTION IN EPICYCLIC GEARS Ph.D. Thesis
John Dennis Andrews 1987 225 p
Avail: Univ. Microfilms Order No. BRD-80914

An investigation of the stress distribution in epicyclic gear components culminates in a design optimization of an epicyclic gear system. Initially, the stresses induced in spur and helical forms of gear teeth were examined with attention focused on the maximum tensile stress attained in the tooth fillets. Validation of results produced by finite element models was achieved by comparison with results obtained by the photoelastic technique. All finite element programs, including those for mesh generation, finite element analysis and graphical pre and post processing, were written by the author. The project then developed into the production of an automatic design algorithm for gears. The criterion on which the design performance was assessed is the maximum tensile stress induced on the gear tooth fillets under working conditions. The design algorithm is demonstrated first by its application to a single spur gear tooth and then to an epicyclic unit comprising a sun wheel, three planet wheels and an annulus, where stresses in all components are considered. This work appears to be the first to attempt to optimize gear design in this manner and also the first which optimizes the design of any continuous system consisting of more than one component. Dissert. Abstr.

N89-13783*# Alabama Univ., Huntsville.
PERSONNEL OCCUPIED WOVEN ENVELOPE ROBOT POWER Final Report, 30 Sep. 1988
F. C. Wessling 20 Oct. 1988 121 p Prepared in cooperation with Pece and Waite, Inc., Huntsville, Ala. and Wyle Labs., Inc., Huntsville, Ala.
(Grant NAGw-847)
(NASA-CR-183271; NAS 1.26:183271) Avail: NTIS HC A06/MF A01 CSCL 13I

The Personnel Occupied Woven Envelope Robot (POWER) concept has evolved over the course of the study. The goal of the project was the development of methods and algorithms for solid modeling for the flexible robot arm. B.G.

N89-13784# Texas A&M Univ., College Station. Turbomachinery Labs.
THE MEASUREMENT AND PREDICTION OF ROTORDYNAMIC FORCES FOR LABYRINTH SEALS Final Report, 1 Sep. 1982 - 31 Dec. 1987
D. W. Childs and D. L. Rhode Mar. 1988 212 p
(Contract F49620-82-K-0033)
(AD-A197185; AFOSR-88-0662TR) Avail: NTIS HC A10/MF A01 CSCL 13G

Measurements of rotordynamic (stiffness and damping) coefficients and leakage characteristics were completed for labyrinth-rotor/honeycombe stator seals. Comparisons to labryinth-rotor/smooth-stator seals showed no stability improvements. Tests were also carried out on smooth-rotor/honeycombe-stator seals and demonstrated superior stability and leakage performance for this type of seal if the entering flow is pre-rotated in the direction of rotation. A new bulk-flow theory for labyrinth seals has been developed and its prediction compares well with measured results for tooth-on-rotor labyrinths. Also, a more sophisticated model was developed which solves the 3-D Reynolds-averaged Navier-Stokes equations for compressible flow. GRA

N89-13785* National Aeronautics and Space Administration. Pasadena Office, Calif.
PASSIVELY ACTIVATED PREHENSILE DIGIT FOR A ROBOTIC END EFFECTOR Patent
Earl R. Collins, Jr., inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 13 Sep. 1988 8 p Filed 21 Oct. 1986 Supersedes N87-14705 (25 - 06, p 781)
(NASA-Case-NPO-16766-1-CU; US-Patent-4,770,455; US-Patent-Appl-SN-921577; US-Patent-Class-294-88; US-Patent-Class-194-902; US-Patent-Class-269-267) Avail: US Patent and Trademark Office CSCL 13I

A common hydraulic reservoir holds one or more rows of slidable pistons or fingers in a base or hand. The individual fingers in each row expose graduated cross sectional fluid application areas to the hydraulic fluid in the reservoir, with the smallest fluid application area in the center of the row and graduating to progressive larger fluid areas towards both ends of each row. The fingers are elongated pistons. Exposed outer ends of each piston extending away from the reservoir, house a transverse pad to contact an object to be held. The transverse pads are universally ball-joint and spring-center mounted in a longitudinally located opening at the outer tapered end of each finger. Simple and effective capacitance metering in the reservoir is provided for each finger. Official Gazette of the U.S. Patent and Trademark Office

N89-13786* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
QUICK-DISCONNECT INFLATABLE SEAL ASSEMBLY Patent
Kurt D. Buehler, inventor (to NASA) and James E. Fesmire, inventor (to NASA) 20 Sep. 1988 9 p Filed 22 May 1987 Supersedes N87-25583 (25 - 19, p 2616)
(NASA-Case-KSC-11368-1; US-Patent-4,772,050; US-Patent-Appl-SN-052940; US-Patent-Class-285-39; US-Patent-Class-285-97; US-Patent-Class-285-107; US-Patent-Class-285-108; US-Patent-Class-285-109; US-Patent-Class-285-133.1; US-Patent-Class-285-351) Avail: US Patent and Trademark Office. CSCL 13K

This invention concerns an inflatable seal assembly adapted for use with a bayonet quick-disconnect system particularly useful for the insulated transfer of cryogenic consumables in orbit (such

as between a space station and a re-supply vehicle). The zero-leak cryogenic coupling includes a polymeric seal clamped to a male bayonet member with two pairs of tightening rings. The tightening rings threadably engage each other in respective pairs around tapered ends of the inflatable seal member so that a wedging action tightens the seal member about the male bayonet. Once in place, the seal may be inflated via an inflation port so that its expansion provides pressure contact with the inside surface of a coaxial female member.

Official Gazette of the U.S. Patent and Trademark Office

N89-13787*# National Aeronautics and Space Administration. Pasadena Office, Calif.

ROTARY CONTROL LOCK

Ted H. Takahashi, inventor (to NASA) and Greg C. Levanas, inventor (to NASA) 23 Sep. 1988 11 p

(Contract NAS7-918)

(NASA-Case-NPO-17453-1-CU; NAS 1.71:NPO-17453-1-CU; US-Patent-Appl-SN-248501) Avail: NTIS HC A02/MF A01 CSCL 13K

The object of this invention is to provide a device that locks potentiometer shafts against rotation, to prevent tampering with the settings of unattended equipment. A major novel feature is a pair of blocks that can each be clamped to a rotary shaft, and a link connecting the blocks to prevent their rotation and therefore prevent rotation of the shafts. NASA

N89-13788*# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.

THERMAL EFFECTS IN TWO-PHASE FLOW THROUGH FACE SEALS Ph.D. Thesis

Prithwish Basu May 1988 166 p

(Grant NAG3-166)

(NASA-CR-180962; NAS 1.26:180962) Avail: NTIS HC A08/MF A01 CSCL 11A

When liquid is sealed at high temperature, it flashes inside the seal due to pressure drop and/or viscous heat dissipation. Two-phase seals generally exhibit more erratic behavior than their single phase counterparts. Thermal effects, which are often neglected in single phase seal analyses, play an important role in determining seal behavior under two-phase operation. It is necessary to consider the heat generation due to viscous shear, conduction into the seal rings and convection with the leakage flow. Analytical models developed work reasonably well at the two extremes - for low leakage rates when convection is neglected and for higher leakage rates when conduction is neglected. A preliminary model, known as the Film Coefficient Model, is presented which considers conduction and convection both, and allows continuous boiling over an extended region unlike the previous low-leakage rate model which neglects convection and always forces a discrete boiling interface. Another simplified, semi-analytical model, based on the assumption of isothermal conditions along the seal interafce, has been developed for low leakage rates. The Film Coefficient Model may be used for more accurate and realistic description. Author

N89-13789# Stanford Univ., Calif. Dept. of Computer Science.

INSTANTANEOUS ROBOT MOTION WITH CONTACT BETWEEN SURFACES Ph.D. Thesis

Chunsheng Cai Jan. 1988 185 p

(Contracts MDA903-86-K-0002; N00039-84-C-0211)

(AD-A198709; SU-STAN-CS-88-1191) Avail: NTIS HC A09/MF A01 CSCL 12I

This research analyzes, the motion constraints needed to maintain direct contact between two rigid bodies, when one or both bodies are being moved under computer control. The author first studies the time-based instantaneous contact kinematics, then develops a control formulation and specifications within the AL robot language for moving so as to maintain the desired contact. Also studied is the impact which results when bodies are moved into direct contact. These studies on robot motion with direct contact between bodies are useful for robot motion planning and control. The author studies the instantaneous contact kinematics, under planar and spatial motion, of a moving object with point or line contact between surfaces. In particular, the velocity, acceleration and jerk of the instantaneous contact point, and the constraints on the angular velocity and angular acceleration for line contact have been obtained as functions of surface geometries and the rigid body motions under contact. These results have been specialized for the study of the special motions of pure rolling and pure sliding, and for the contact geometries where contact occurs on a sharp edge or a plane. They have also been used to study bodies moving with multiple contacts. GRA

N89-13790# Stanford Univ., Calif. Dept. of Computer Science.

DYNAMICS FOR ROBOT CONTROL: FRICTION MODELING AND ENSURING EXCITATION DURING PARAMETER IDENTIFICATION Ph.D. Thesis

Brian S. Armstrong May 1988 195 p

(AD-A198732; SU-STAN-CS-88-1205) Avail: NTIS HC A09/MF A01 CSCL 20K

To accurately control any mechanism it is necessary to know the relationship between applied forces and the resultant motion. These forces may be simple to compute, as is the case for many single degree of freedom machines; or they may be quite complex. Two steps toward the accurate prediction of motion forces are presented in this thesis: an experimental investigation of friction, and a study of the sensitivity of robot inertial parameter identification methods to noise. The friction study begins with an experimental investigation of the most basic properties required for predictive modeling: repeatability and structure. Friction is found to be surprisingly repeatable; position dependence is found, and a destabilizing effect - the Stribeck effect - is observed at low velocity. The experimental work is specific to a particular mechanism: the PUMA 560 arm; but many of the observations, particularly the study of the Stribeck effect, will extend to a broad class of machines. Using the friction model developed and an inertial model reported elsewhere, open-loop control of the PUMA robot is carried out, demonstrating the accuracy of the friction model. GRA

N89-13791# Sandia National Labs., Albuquerque, N. Mex. Component Development Div.

AN INVESTIGATION OF THE ELASTIC-PLASTIC BEHAVIOR OF EXPLOSIVELY ACTUATED VALVES

A. F. Emery, B. K. Jones (Washington Univ., Seattle.), M. F. Hardwick, and R. Ng Jul. 1988 36 p

(Contract DE-AC04-76DR-00789)

(DE88-017227; SAND-88-8214) Avail: NTIS HC A03/MF A01

MAVIS is a computer program for the modeling and analysis of explosive valves. Until recently, the drag forces between the plunger and the housing have been calculated by modeling the valve as a series of thin disks, then assuming an elastic interference fit between the disks of the plunger and the disks of the housing. Explosive valves constructed with new materials and new geometries, however, have made it necessary to account for plastic deformations, including strain hardening, in the MAVIS disk model. This report introduces an elastic-plastic disk model based on a combination of closed form and finite element results. The behavior of the MAVIS calculations with elastic-plastic materials is compared to various finite element representations of an explosive valve to verify the disk model and to quantify the effects of plasticity and large deformations. Finally, the elastic-plastic MAVIS calculations are compared to experimental results obtained from test valves with various materials and geometries. DOE

N89-13792# Sandia National Labs., Albuquerque, N. Mex.

ROBOTICS RESEARCH AT SANDIA NATIONAL LABORATORIES

Patrick J. Eicker 1988 16 p Presented at the International Symposium and Exposition on Robots, Sydney, Australia, 6 Nov. 1988

(Contract DE-AC04-76DP-00789)

(DE88-009259; SAND-88-0301C; CONF-881118-1) Avail: NTIS HC A03/MF A01

Robotics research at Sandia National Laboratories is assisting in the automation of operations with in the United States

Department of Energy complex. The operations addressed have the characteristics of a batch environment. The research is thus aimed at giving robots the sensing and intelligence which can improve their cost effectiveness in an environment less structured than that encountered in mass production. DOE

N89-13793*# California Univ., Santa Barbara. Dept. of Mechanical Engineering.
GEAR OPTIMIZATION Final Contractor Report
G. N. Vanderplaats, Xiang Chen, and Ning-tian Zhang Washington NASA Dec. 1988 65 p
(Grant NAG3-683)
(NASA-CR-4201; E-4459; NAS 1.26:4201) Avail. NTIS HC A04/MF A01 CSCL 13I

The use of formal numerical optimization methods for the design of gears is investigated. To achieve this, computer codes were developed for the analysis of spur gears and spiral bevel gears. These codes calculate the life, dynamic load, bending strength, surface durability, gear weight and size, and various geometric parameters. It is necessary to calculate all such important responses because they all represent competing requirements in the design process. The codes developed here were written in subroutine form and coupled to the COPES/ADS general purpose optimization program. This code allows the user to define the optimization problem at the time of program execution. Typical design variables include face width, number of teeth and diametral pitch. The user is free to choose any calculated response as the design objective to minimize or maximize and may impose lower and upper bounds on any calculated responses. Typical examples include life maximization with limits on dynamic load, stress, weight, etc. or minimization of weight subject to limits on life, dynamic load, etc. The research codes were written in modular form for easy expansion and so that they could be combined to create a multiple reduction optimization capability in future. Author

N89-13794*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF ADVANCED COMPONENT TECHNOLOGY ON HELICOPTER TRANSMISSIONS
David G. Lewicki and Dennis P. Townsend 1989 18 p Prepared for presentation at the International Power Transmission and Gearing Conference, Chicago, Ill., 25-27 Apr. 1989; sponsored by ASME Prepared in cooperation with Army Aviation Systems Command, Cleveland, Ohio
(NASA-TM-101431; E-4531; NAS 1.15:101431; AVSCOM-TR-87-C-38) Avail: NTIS HC A03/MF A01 CSCL 01C

Experimental tests were performed on the NASA/Bell Helicopter Textron (BHT) 500 hp advanced technology transmission (ATT) at the NASA Lewis Research Center. The ATT was a retrofit of the OH-58C helicopter 236 kW (317 hp) main rotor transmission, upgraded to 373 kW (500 hp), with a design goal of retaining long life with a minimum increase in cost, weight, and size. Vibration, strain, efficiency, deflection, and temperature experiments were performed and the results were compared to previous experiments on the OH-58A, OH-58C, and UH-60A transmissions. The high-contact-ratio gears and the cantilevered-mounted, flexible ring gear of the ATT reduced vibration compared to that of the OH-58C. The ATT flexible ring gear improved planetary load sharing compared to that of the rigid ring gear of the UH-60A transmission. The ATT mechanical efficiency was lower than that of the OH-58A transmission, probably due to the high-contact-ratio planetary gears. Author

N89-14156*# Iowa State Univ. of Science and Technology, Ames.
THREE DEGREE-OF-FREEDOM FORCE FEEDBACK CONTROL FOR ROBOTIC MATING OF UMBILICAL LINES
R. Rees Fullmer *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 19-41 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 13I

N89-14169*# Oregon Inst. of Tech., Klamath Falls. Dept. of Electronics.
ADAPTIVE SERVO CONTROL FOR UMBILICAL MATING
Omar Zia *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 487-519 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N89-13795# Technical Univ. of Istanbul (Turkey). Inst. for Nuclear Energy.
RADIOGRAPHIC EVALUATION FOR INSPECTION OF STEEL CASTING AND WELDING PARTS
A. Nasihi Bilge and Beril Tugrul 1986 11 p In TURKISH Presented at the Industrial Cooperation in the Field of Nuclear Technology, Istanbul, Turkey, 15 Oct. 1986
(DE88-703913; INIS-mf-11295; CONF-8610433) Avail: NTIS (US Sales Only) HC A03/MF A01

Evaluation of the radiographs is an important stage of the radiography technique. In this study, the basis of the evaluation is defined and related international references are given with examples. Radiographic inspections for steel casting and welding parts are expanded applications. In Turkey, industrial quality controls are realized mostly on this type of materials. The important points and different types of the discontinuities are explained with some radiographs. DOE

N89-13502# Joint Publications Research Service, Arlington, Va.
INSPECTION OF CFRP BY INDUSTRIAL X-RAY CT SCANNER
Mineo Maruoka, Hideki Ohashi, and Masashi Fujii *In its* JPRS Report: Science and Technology. Japan: 12th Composite Materials Symposium 23 Sep. 1988 p 9-14 Transl. into ENGLISH from Daijunikai Fukugo Zairyo Symposium (Koen Yoshishu), (Tokyo, Japan), 22-23 Oct. 1987 p 47-50 (For primary document see N89-13500 05-24)
Avail: NTIS HC A05/MF A01

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N89-13796 Old Dominion Univ., Norfolk, Va.
THE EFFECTS OF NONLINEAR DAMPING ON THE LARGE DEFLECTION RESPONSE OF STRUCTURES SUBJECTED TO RANDOM EXCITATION Ph.D. Thesis
Chunchu Bhavani Prasad 1987 161 p
Avail: Univ. Microfilms Order No. DA8805584

Effects of both nonlinear damping and large deflection stiffness are included in the theoretical anlaysis in an attempt to explain the experimental phenomena of aircraft panels excited at high sound pressure levels; that is the broadening of the strain response peak and the increase in modal frequency. Beams and symmetrically laminated plates subjected to acoustic excitation are considered in the analyses. A polynomial containing both linear and nonlinear damping terms is considered as a damping model. The Galerkin method is used to derive modal equations. Direct equivalent linearization is used to solve nonlinear damping terms

to determine mean square maximum deflection, mean square maximum strain, and spectral density function of maximum strain for the structures. For beams, simply supported and clamped, three modes are considered in the analysis. Isotropic material is considered for beams. For laminated plates, simply supported and clamped, only single mode analysis is performed. This analytical investigation will help to broaden the basic understanding of the role of nonlinear damping on random response of structures and lead to better sonic fatigue design criteria. Dissert. Abstr.

N89-13797 Stanford Univ., Calif.
THE INFLUENCE OF CONSTITUTIVE BEHAVIOR ON THE SHEET METAL FORMING LIMIT STRAINS PREDICTED USING AN IMPERFECTION GROWTH MODEL Ph.D. Thesis
Douglas Dean Olander 1988 398 p
Avail: Univ. Microfilms Order No. DA8808399

Sheet metal forming limit strains for proportional and nonproportional loading histories were predicted using an imperfection growth model. This model is the generally accepted method for prediction of forming limit strains in sheet materials. The influence of constitutive behavior on the forming limit strains predicted using this model were studied. The forming limit strain determined experimentally in sheet metals are found to be dependent on the imposed strain path as a result of the history dependence of nonelastic deformation. The MATMOD-4V-2D constitutive equations were utilized to predict history dependent constitutive behavior in an imperfection growth model. The use of complex constitutive behavior increased the predictive capability of the imperfection growth model for predicting sheet metal forming limit strains as well as developing insight into the physical processes important in optimizing formability. Forming limit strains were predicted with increased quantitative accuracy. The complex constitutive behavior allowed for prediction of behavior observed to be associated with aluminum alloy-like materials as well as steel-like materials when subjected to nonproportional loading histories. Through the structure evolution predicted for nonproportional loading histories, insight into the material processes which must be considered to optimize sheet metal formability were defined. Formability enhancements were predicted in materials where kinematic contributions dominated the overall bearing hardening behavior of a material Dissert. Abstr.

N89-13798# Sydney Univ. (Australia). School of Civil and Mining Engineering.
FAILURE OF TWO PROTOTYPE TORISPHERICAL SHELLS UNDER INTERNAL PRESSURE
M. J. Blackler and P. Ansourian Dec. 1987 41 p
(PB88-232004; R-557) Avail: NTIS HC A03/MF A01 CSCL 20K

The behavior of two prototype torispherical shells of stainless steel is described under internal pressure, and the failure mode and pressure is assessed in relation to existing or propossed design recommendations. The two tanks had been in service for about 20 years as vertical brewing fermenters in the brewing industry when they became available for testing to failure. They are of welded stainless steel construction throughout, with the exception of a mild steel skirt affixed to the lower knuckle/cylinder junction. The major parts are spherical end caps, toroidal knuckles and a cylindrical body. GRA

N89-13799*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
SENSITIVITY, OPTIMAL SCALING AND MINIMUM ROUNDOFF ERRORS IN FLEXIBLE STRUCTURE MODELS Progress Report
Robert E. Skelton [1987] 84 p
(Grant NAG1-857)
(NASA-CR-183197; NAS 1.26:183197) Avail: NTIS HC A05/MF A01 CSCL 20K

Traditional modeling notions presume the existence of a truth model that relates the input to the output, without advanced knowledge of the input. This has led to the evolution of education and research approaches (including the available control and robustness theories) that treat the modeling and control design as separate problems. The paper explores the subtleties of this presumption that the modeling and control problems are separable. A detailed study of the nature of modeling errors is useful to gain insight into the limitations of traditional control and identification points of view. Modeling errors need not be small but simply appropriate for control design. Furthermore, the modeling and control design processes are inevitably iterative in nature.
Author

N89-13800# Carnegie-Mellon Univ., Pittsburgh, Pa.
AN EFFICIENT METHOD FOR PREDICTING THE VIBRATORY RESPONSE OF LINEAR STRUCTURES WITH FRICTION INTERFACES. VOLUME 1: THEORY AND APPLICATION Final Report, May 1983 - Oct. 1986
Enrique Bazan-Zurita, Jacobo Bielak, and Jerry H. Griffin 29 Mar. 1988 50 p
(Contract F33615-83-K-2316)
(AD-A197447; R-86-158-Vol-1; R-86-159-Vol-1; AFWAL-TR-86-2119-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 21E

One important consideration in the design of gas turbine engines is limiting the amplitudes of steady-state vibrations of its components in order to prevent failures due to high cycle fatigue. The most widely used damping devices incorporate especially designed friction interfaces which dissipate energy and reduce high frequency vibrations to an acceptable level. A simple methodology to study the steady-state response of systems consisting of linear elastic substructures connected by friction interfaces is presented. Assuming that only the first Fourier components of the friction forces contribute significantly to the system response, the differential equations of motion are transformed into a system of algebraic complex equations for different normal loads in the friction interfaces. As part of the solution procedure, a criterion to determine the slip-to-stuck transitions in the joint is proposed. Within the assumption that the response is harmonic, any desired accuracy can be obtained with this methodology. Data structures and algorithms for the automatic formulation of the system of algebraic complex equations are also developed. Selected numerical examples are presented to illustrate practical applications and the relevant features of the methodology. Due to its simplicity, this methodology is particularly appropriate for performing parametric studies that require solutions for many values of normal loads. GRA

N89-13801# Naval Research Lab., Washington, D.C.
THEORETICAL PREDICTION OF RIPPLE-LOAD EFFECT ON STRESS-CORROSION CRACKING
George R. Yoder, Peter S. Pao, and R. A. Bayles 31 May 1988 16 p
(AD-A196348; AD-E951145; NRL-MR-6215) Avail: NTIS HC A03/MF A01 CSCL 20K

The ripple load effect (RLE) is a perplexing phenomenon in which the threshold stress intensity factor for stress corrosion cracking (SCC) appears to be severely degraded, at least in some cases, if the constant load condition characteristic of SCC is perturbed by superposition of a small amplitude cyclic load. In this study, a theoretical framework was developed to predict the conditions required for a material to exhibit a RLE in a marine environment, and the extent of such degradation. Insofar as a framework for the RLE necessarily involves the interface between SCC and corrosion fatigue (CF), the model presented herein derives from concepts and descriptors used in SCC and CF characterization. Thus, analysis begins with consideration of the relationship between the small amplitude stress intensity range associated with ripple loading, delta K, the high stress ratio condition, R is greater than 0.90, the threshold for CF crack growth, delta Kth, the maximum stress intensity factor in the loading cycle, Kmax, and KIscc. Author

N89-13802*# Washington Univ., St. Louis, Mo.
HIERARCHIC PLATE AND SHELL MODELS BASED ON p-EXTENSION

Barna A. Szabo and Glenn J. Sahrmann Washington NASA Dec. 1988 45 p Presented at the Conference on The Impact of Mathematical Analysis on the Numerical Solution of Engineering Problems, College Park, Md., 17-19 Sep. 1986
(Grant NAG1-639)
(NASA-CR-4203; NAS 1.26:4203; WU/CCM-87/5) Avail: NTIS HC A03/MF A01 CSCL 20K

Formulations of finite element models for beams, arches, plates and shells based on the principle of virtual work was studied. The focus is on computer implementation of hierarchic sequences of finite element models suitable for numerical solution of a large variety of practical problems which may concurrently contain thin and thick plates and shells, stiffeners, and regions where three dimensional representation is required. The approximate solutions corresponding to the hierarchic sequence of models converge to the exact solution of the fully three dimensional model. The stopping criterion is based on: (1) estimation of the relative error in energy norm; (2) equilibrium tests, and (3) observation of the convergence of quantities of interest. Author

N89-13803# Maryland Univ., College Park. Inst. for Advanced Computer Studies.
STRESS COMPUTATIONS FOR NEARLY INCOMPRESSIBLE MATERIALS
Barna A. Szabo, Ivo Babuska, and Bidar K. Chayapathy Apr. 1988 29 p Prepared in cooperation with Washington Univ., St. Louis, Mo.
(Contract N00014-85-K-0169; NSF DMC-86-06533)
(AD-A198729; WU/CCM-88) Avail: NTIS HC A03/MF A01 CSCL 20D

The problem of computing stresses accurately and reliably in the case of nearly incompressible solids and in the incompressible limit of the compressible Navier-Stokes equations has received a great deal of attention in recent years. Formulations based on the principle of virtual work have been abandoned in favor of mixed and penalty methods in order to avoid locking which occurs when elements of low polynomial degree are used. An overview of the evolution of mixed and penalty methods and a clear exposition of the locking phenomenon is available. A mixed formulation which has been successfully applied to elastic and inelastic problems is presented. Mixed formulations have been used successfully in fluid dynamics in conjunction with elements of high polynomial degree. GRA

N89-13804# Aeronautical Research Labs., Melbourne (Australia).
THREE DIMENSIONAL COMPUTATION OF STRESS, STRAIN AND STRAIN ENERGY DENSITY UNDER INTERFERENCE-FIT AND AFTER COLD-WORKING OF HOLES
R. P. Carey Jan. 1988 35 p
(AD-A198764; ARL-STRUC-TM-478) Avail: NTIS HC A03/MF A01 CSCL 11F

Stress, strain and strain energy density distributions are computed by three-dimensional finite element analysis for interference fit and cold-worked conditions for a steel pin in an annular aluminium alloy plate, the plate thickness being equal to the pin diameter. Comparisons are made with the appropriate results from two-dimensional analyses. GRA

N89-13805# Ohio State Univ., Columbus. Research Foundation.
ANALYSIS OF STRESSES AND FORCE RESULTANTS IN OBLONG CONDUITS UNDER UNIFORMLY DISTRIBUTED LOADS Final Technical Report
Ranbir S. Sandhu and Chia-chi Chen Aug. 1988 51 p Sponsored by Army Corps of Engineers, Washington, D.C.
(AD-A198853; OSURF-SER-18; WES/TR/SL-88-32) Avail: NTIS HC A04/MF A01 CSCL 11B

Finite element techniques were used to evaluate the stresses and force resultants in oblong reinforced concrete conduits. Steel ratios were varied. The analyses showed that the presence of steel has little effect on the force resultants but does influence the stress distribution in the vicinity of the reinforcement. Tables of moment, thrust, and shear parameters for two shapes are included. GRA

N89-13806# Washington Univ., Seattle. Dept. of Mechanical Engineering.
HRR FIELD OF A MOVING CRACK: AN EXPERIMENTAL ANALYSIS
Mahyar S. Dadkhah and Albert S. Kobayashi Sep. 1988 18 p
(Contract N00014-85-K-0187)
(AD-A198931; UWA/DME/TR-88/60) Avail: NTIS HC A03/MF A01 CSCL 11F

An improved moire interferometry was used to record simultaneously both the vertical and horizontal displacements associated with stable crack growth in uniaxially and biaxially loaded 2024-0 and 2024-T3 aluminum, single edge notched specimens. For stable crack growth up to 5 mm, the vertical displacement field showed the dominance of the HRR field but the HRR field was detected in the horizontal displacement only at the initial stage of loading. The far and near field J-integrals were path independent and yielded the correct crack tip displacements only at the initial stage of loading in the horizontal direction and at the terminal stage of loading in the vertical displacement field. The preliminary results indicate that the J-characterization of a moving crack, including that of rapid propagation, may not be valid for these ductile materials for this specimen configuration. GRA

N89-13807# Pittsburgh Univ., Pa.
GENERATIVE PROCESSES IN REPRESENTATIONS OF PROBLEMS Final Technical Report, 6 Mar. 1984 - 5 Mar. 1987
Lauren B. Resnick 9 Aug. 1988 25 p
(Contract N00014-84-K-0223; RR04206)
(AD-A199036) Avail: NTIS HC A03/MF A01 CSCL 20K

Addressing questions concerning representation and restructuring in the domain of mechanics, this research sought to identify basic representational structures involving forces, objects, and motions and to show how people use them to construct predictions and explanations in particular situations. A closely related objective was to examine the nature of representational change, both spontaneous and stimulated by different forms of instruction. We conducted two sets of studies examining the nature and use of physics knowledge on the part of naive individuals--those having never formally studied physics. The first study was descriptive, examining the extent to which naive reasoners about physics can be said to work from theoretical principles, as opposed to constructing ad hoc, local explanations that cannot properly be called theories. The second focused on restructuring as a result of certain kinds of feedback. Subjects appeared to have organized ideas about how forces and motions combine, but they made distinctions among situations that would not be needed within Newtonian theory. Results of these studies invite further investigation of both the structure of naive representations and the conditions and processes of restructuring. GRA

N89-13808# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
GUIDED ELASTIC INTERFACE WAVES FOR CERAMIC JOINT EVALUATION
W. A. Simpson, Jr. and R. W. McClung 1988 9 p Presented at the Review of Progress in Quantitative Nondestructive Evaluation, La Jolla, Calif., 31 Jul. 1988
(Contract DE-AC05-84OR-21400)
(DE88-016790; CONF-880760-3) Avail: NTIS HC A02/MF A01

Because of their excellent thermal and wear properties, structural ceramics are finding increasing use in applications that have traditionally been reserved for metals. Since many ceramics remain stables at temperatures well in excess of the melting points of virtually all of the common structural metals, one such application is in high-temperature engines, where the relatively low weight of ceramics provides an additional advantage over such competitors as refractory metals. Unfortunately, with the relatively low fracture toughness and poor machinability of ceramics, practical designs, at least for the near future, will probably consist of ceramic liners

attached to metal substrates, thereby combining the wear and thermal properties of ceramics with the strength of metals. This configuration introduces new problems, however, since one must now guarantee the integrity of the ceramic-to-metal joint as well as that of the component parts themselves. In considering possible nondestructive techniques to achieve the goals of bond strength determination and assessment of the elastic properties of the materials in and adjacent to the bond, it is clear that conventional elastic bulk waves will be of limited usefulness. However, if one could propagate an elastic wave along the bond layer, and which was evanescent in the materials on either side of the bond, then both goals could possibly be achieved simultaneously. This report discusses this approach. DOE

N89-13809*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.

FREQUENCY BASED LOCALIZATION OF STRUCTURAL DISCREPANCIES

G. D. Shepard (Lowell Univ., Mass.) and J. Milani Oct. 1988 25 p

(Contract NAS9-17560)

(NASA-CR-172107; NAS 1.26:172107; CSDL-P-2827) Avail: NTIS HC A03/MF A01 CSCL 20K

The intent of modal analysis is to develop a reliable model of a structure by working with the analytical and experimental modal properties of frequency, damping and mode shape. In addition to identifying these modal properties, it would be desirable to determine spatially which parts of the structure are modelled poorly or well. It is shown how the pattern of discrepancies in the analytical and experimental test values for the pole and the driving point zero frequencies of a structure can be linked to discrepancies in the mass or stiffness of the structural elements. The success of the procedure depends on the numerical conditioning of a modal reference matrix. Strategies to insure adequate numerical conditioning require a formulation which avoids geometric and energy storage symmetries of the structure, and ignores structural elements which contribute negligibly small potential or kinetic energy to the excited modes. Physical insight into the numerical conditioning problem is provided by a numerical example and by localization of a mass discrepancy in a real structure based on lab tests. Author

N89-13810*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE COMPUTATIONAL STRUCTURAL MECHANICS TESTBED DATA LIBRARY DESCRIPTION

Caroline B. Stewart, comp. (Analytical Services and Materials, Inc., Hampton, Va.) Oct. 1988 137 p

(NASA-TM-100645; NAS 1.15:100645) Avail: NTIS HC A07/MF A01 CSCL 20K

The datasets created and used by the Computational Structural Mechanics Testbed software system is documented by this manual. A description of each dataset including its form, contents, and organization is presented. Author

N89-13811# Southwest Research Inst., San Antonio, Tex.

ADVANCED MODELING FOR FATIGUE GROWTH OF SMALL SURFACE CRACKS Final Report, 1 Apr. 1986 - 31 Mar. 1988

T. A. Cruse and S. T. Raveendra 31 May 1988 107 p

(Contract F49620-86-C-0048)

(AD-A198077; AFOSR-88-0803TR) Avail: NTIS HC A06/MF A01 CSCL 11F

The primary result of the sponsored research is the development and application of the boundary element method for two- and three-dimensional fatigue crack growth analysis. The two-dimensional formulation developed previously (AFOSR Contract No. F49620-84-C-0042) was extended to investigate the crack tip behavior of long and short cracks under cyclic loading. The influence of residual plasticity on stress intensity factor was used to obtain an unambiguous estimate of the plastic zone size. It was demonstrated that the effect of the plastic wake on the stress intensity factor for crack opening (closure) and the effect of the residual stress on the retardation are identical manifestations of the same plasticity process. The boundary integral equations also provide insight to the mathematical equivalence of these two effects. GRA

N89-13812# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Macromolecular Science.

A PROBABILISTIC MODEL OF BRITTLE CRACK FORMATION Interim Report, Apr. 1987 - Mar. 1988

A. Moet, D. Dearth, H. Aglan, A. Chudnovsky, and B. Kunin (Illinois Univ., Chicago.) Jul. 1988 63 p

(Contract N00014-86-K-0285)

(AD-A198203) Avail: NTIS HC A04/MF A01 CSCL 11D

Multiple experience on macroscopically identical 3-d carbon-carbon (C/C) composite specimens show that the fracture behavior displays the main features of a stochastic process which reflects the random nature of the strength field. The critical load is random and a sample set of crack trajectories displays a Poisson's type diffuse character. Crack trajectories are unique for each individual experiment (no two coincide). The crack appears to propagate stepwise (a sequence of local failures) through a random field of defects which is constrained by the orthotropic architecture of the yarn bundles. GRA

N89-13813# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Civil Engineering.

SMALL STRAIN RESPONSE OF RANDOM ARRAYS OF ELASTIC SPHERES USING A NONLINEAR DISTINCT ELEMENT PROCEDURE Annual Report, 6 May 1987 - 5 May 1988

Emmanuel Petrakis, Ricardo Dobry, and Tang-Tat Ng Jul. 1988 65 p

(Grant AF-AFOSR-0135-86; AF Proj. 2302)

(AD-A198281; RPI-CE-88-02; AFOSR-88-0910TR) Avail: NTIS HC A04/MF A01 CSCL 07D

Granular soil is presented in this work by 2-D random arrays of elastic, rough, quartz sphere using the distinct element method. The original 3-D computer code TRUBAL, originally developed by Peter Cundall, has been modified at RPI by the introduction of a general solution to the Hertz-Mindlin contact problem. This was achieved by attaching a subroutine to the original code, which describes the nonlinear force-displacement relationship at the intergranular contacts, by means of plasticity theory and kinematic hardening. The above modified program (CONBAL-2) developed as part of another RPI project, can perform 2-D simulations and has already been used to study the dynamic small strain behavior as well as the large strain behavior of sand. GRA

N89-13814*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EFFECTS OF VARIABLES UPON PYROTECHNICALLY INDUCED SHOCK RESPONSE SPECTRA, PART 2

James Lee Smith Nov. 1988 106 p

(NASA-TP-2872; NAS 1.60:2872) Avail: NTIS HC A06/MF A01 CSCL 20K

Throughout the aerospace industry, large variations of 50 percent (6 dB) or more in shock response spectra (SRS) derived from pyrotechnic separation events continue to be reported from actual spaceflight data and from laboratory tests. As a result of these variations, NASA funded a research program for 1984 through 1986. The purpose of the 1984 through 1986 project was to analyze variations in pyrotechnically induced SRS and to determine if and to what degree manufacturing and assembly variables and tolerances, distance from the shock source, data acquisition instrumentation, and shock energy propagation affect the SRS. Sixty-four free-free boundary plate tests were performed. NASA funded an additional study for 1987 through 1988. This paper is a summary of the additional study. The purpose was to evaluate shock dissipation through various spacecraft structural joint types, to evaluate shock variation for various manufacturing and assembly variables on clamped boundary test plates, and to verify data correction techniques. Five clamped boundary plate tests investigated manufacturing and assembly variables and mass

loading effects. Six free-free boundary plate tests investigated shock dissipation across spacecraft joint structures. Author

N89-13815*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SPACE CRANE CONCEPT: PRELIMINARY DESIGN AND STATIC ANALYSIS
Martin M. Mikulas, Jr., Robert C. Davis, and William H. Greene Nov. 1988 18 p
(NASA-TM-101498; NAS 1.15:101498) Avail: NTIS HC A03/MF A01 CSCL 20K

Future in-space construction and assembly facilities will require the use of space cranes capable of supporting and manipulating large and massive loads. The large size of the space components being considered for construction will require that these cranes have a reach on the order of 100 meters. A space crane constructed from an erectable four-longeron truss beam with 19 5-sq-m truss bays is considered. This concept was selected to be compatible with the Space Station truss. This truss is hinged at three locations along its bottom edge and attached at one end to a rotary-joint cantilevered to the assembly depot's main truss structure. The crane's boom sections are rotated by extensible longeron actuators located along the top edge of the beam. To achieve maximum position maneuvering capability for the crane requires that the individual sections be capable of rotating 180 degrees about the hinge point. This can only be accomplished by offsetting the hinges from the longeron axes. Since offset hinges introduce bending moments in the truss members, an analysis of the effect of hinge offsets on the load-carrying capacity of the structure is required. The objective of the static finite element analysis described is to determine the effect of various offset lengths on the overall bending stiffness of the crane and on the maximum stresses. Author

N89-13816*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, Calif.
BUCKLING CHARACTERISTICS OF HYPERSONIC AIRCRAFT WING TUBULAR PANELS
William L. Ko, John L. Shideler (National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.), and Roger A. Fields Dec. 1986 70 p
(NASA-TM-87756; L-16128; NAS 1.15:87756) Avail: NTIS HC A04/MF A01 CSCL 20K

The buckling characteristics of Rene 41 tubular panels installed as wing panels on a hypersonic wing test structure (HWTS) were determined nondestructively through use of a force/stiffness technique. The nondestructive buckling tests were carried out under different combined load conditions and different temperature environments. Two panels were subsequently tested to buckling failure in a universal tension compression testing machine. In spite of some data scattering because of large extrapolations of data points resulting from termination of the test at a somewhat low applied load, the overall test data correlated fairly well with theoretically predicted buckling interaction curves. The structural efficiency of the tubular panels was slightly higher than that of the beaded panels which they replaced. Author

N89-13817*# Florida Atlantic Univ., Boca Raton. Dept. of Ocean Engineering.
APPLICATION OF THE MOBILITY POWER FLOW APPROACH TO STRUCTURAL RESPONSE FROM DISTRIBUTED LOADING Progress Report
J. M. Cuschieri Dec. 1988 19 p
(Grant NAG1-685)
(NASA-CR-181342; NAS 1.26:181342) Avail: NTIS HC A03/MF A01 CSCL 20K

The problem of the vibration power flow through coupled substructures when one of the substructures is subjected to a distributed load is addressed. In all the work performed thus far, point force excitation was considered. However, in the case of the excitation of an aircraft fuselage, distributed loading on the whole surface of a panel can be as important as the excitation from directly applied forces at defined locations on the structures. Thus using a mobility power flow approach, expressions are developed for the transmission of vibrational power between two coupled plate substructures in an L configuration, with one of the surfaces of one of the plate substructures being subjected to a distributed load. The types of distributed loads that are considered are a force load with an arbitrary function in space and a distributed load similar to that from acoustic excitation. Author

N89-13818*# Lockheed Missiles and Space Co., Palo Alto, Calif.
UTILITIES FOR MASTER SOURCE CODE DISTRIBUTION: MAX AND FRIENDS
Carlos A. Felippa Oct. 1988 69 p
(Contract NAS1-18444)
(NASA-CR-178383; NAS 1.26:178383; LMSC-D812789) Avail: NTIS HC A04/MF A01 CSCL 20K

MAX is a program for the manipulation of FORTRAN master source code (MSC). This is a technique by which one maintains one and only one master copy of a FORTRAN program under a program developing system, which for MAX is assumed to be VAX/VMS. The master copy is not intended to be directly compiled. Instead it must be pre-processed by MAX to produce compilable instances. These instances may correspond to different code versions (for example, double precision versus single precision), different machines (for example, IBM, CDC, Cray) or different operating systems (i.e., VAX/VMS versus VAX/UNIX). The advantage os using a master source is more pronounced in complex application programs that are developed and maintained over many years and are to be transported and executed on several computer environments. The version lag problem that plagues many such programs is avoided by this approach. MAX is complemented by several auxiliary programs that perform nonessential functions. The ensemble is collectively known as MAX and Friends. All of these programs, including MAX, are executed as foreign VAX/VMS commands and can easily be hidden in customized VMS command procedures. Author

N89-13819*# Toledo Univ., Ohio.
SOLUTION AND SENSITIVITY ANALYSIS OF A COMPLEX TRANSCENDENTAL EIGENPROBLEM WITH PAIRS OF REAL EIGENVALUES Final Report
Durbha V. Murthy Jan. 1989 25 p
(Grant NAG3-742)
(NASA-CR-182241; E-4560; NAS 1.26:182241) Avail: NTIS HC A03/MF A01 CSCL 20K

This paper considers complex transcendental eigenvalue problems where one is interested in pairs of eigenvalues that are restricted to take real values only. Such eigenvalue problems arise in dynamic stability analysis of nonconservative physical systems, i.e., flutter analysis of aeroelastic systems. Some available solution methods are discussed and a new method is presented. Two computational approaches are described for analytical evaluation of the sensitivities of these eigenvalues when they are dependent on other parameters. The algorithms presented are illustrated through examples. Author

N89-13820*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Civil Engineering.
LOCAL-GLOBAL ANALYSIS OF CRACK GROWTH IN CONTINUOUSLY REINFORCED CERAMIC MATRIX COMPOSITES Final Report
Roberto Ballarini and Shamin Ahmed Dec. 1988 26 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989
(Grant NAG3-856)
(NASA-CR-182231; E-4537; NAS 1.26:182231) Avail: NTIS HC A03/MF A01 CSCL 20K

The development is described of a mathematical model for predicting the strength and micromechanical failure characteristics of continuously reinforced ceramic matrix composites. The local-globe analysis models the vicinity of a propagating crack tip as a local heterogeneous region (LHR) consisting of spring like

representation of the matrix, fibers and interfaces. This region is embedded in an anisotropic continuum (representing the bulk composite) which is modeled by conventional finite elements. Parametric studies are conducted to investigate the effects of LHR size, component properties, interface conditions, etc. on the strength and sequence of the failure processes in the unidirectional composite system. The results are compared with those predicted by the models developed by Marshall et al. (1985) and by Budiansky et al. (1986). Author

N89-14157*# North Carolina State Univ., Raleigh. Dept. of Civil and Mechanical Engineering.
SHOCK SPECTRA APPLICATIONS TO A CLASS OF MULTIPLE DEGREE-OF-FREEDOM STRUCTURES SYSTEM
Shoi Y. Hwang *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 42-77 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 20K

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N89-13821*# Columbia Univ., New York, N.Y. Dept. of Geography.
DEVELOPMENT OF A GROUND HYDROLOGY MODEL SUITABLE FOR GLOBAL CLIMATE MODELING USING SOIL MORPHOLOGY AND VEGETATION COVER, AND AN EVALUATION OF REMOTELY SENSED INFORMATION Final Technical Report, 1 Jan. 1984 - 31 May 1988
L. Zobler and R. Lewis 26 Oct. 1988 5 p
(Contract NCC5-32)
(NASA-CR-180463; NAS 1.26:180463) Avail: NTIS HC A02/MF A01 CSCL 08H

The long-term purpose was to contribute to scientific understanding of the role of the planet's land surfaces in modulating the flows of energy and matter which influence the climate, and to quantify and monitor human-induced changes to the land environment that may affect global climate. Highlights of the effort include the following: production of geo-coded, digitized World Soil Data file for use with the Goddard Institute for Space Studies (GISS) climate model; contribution to the development of a numerical physically-based model of ground hydrology; and assessment of the utility of remote sensing for providing data on hydrologically significant land surface variables. Author

N89-13822*# National Marine Fisheries Service, Miami, Fla.
UTILIZING REMOTE SENSING OF THEMATIC MAPPER DATA TO IMPROVE OUR UNDERSTANDING OF ESTUARINE PROCESSES AND THEIR INFLUENCE ON THE PRODUCTIVITY OF ESTUARINE-DEPENDENT FISHERIES Semiannual Progress Report No. 5
Joan A. Browder, L. Nelson May, Jr., Alan Rosenthal, Robert H. Baumann, and James G. Gosselink (Louisiana State Univ., Baton Rouge.) 10 Jun. 1988 51 p
(NASA-CR-183409; NAS 1.26:183409) Avail: NTIS HC A04/MF A01 CSCL 08B

The continuing disintegration of the coastal marshes of Louisiana is one of the major environmental problems of the nation. The problem of marsh loss in Louisiana is relevant to fishery management because Louisiana leads the nation in landings of fishery products, and most of the landed species are dependent upon estuaries and their associated tidal marshes. In evaluating the potential effect of marshland loss on fisheries, the first two critical factors to consider are: whether land-water interface in actual disintegrating marshes is currently increasing or decreasing, and the magnitude of the change. In the present study, LANDSAT Thematic Mapper (TM) data covering specific marshes in coastal Louisiana were used to test conclusions from the Browder et al (1984) model with regard to the stage in disintegration at which maximum interface occurs; to further explore the relationship between maximum interface and the pattern of distribution of land and water suggested by the model; and to determine the direction and degree of change in land-water interface in relation to land loss in actual marshes. Author

N89-13823*# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
USE OF LANDSAT IMAGES OF VEGETATION COVER TO ESTIMATE EFFECTIVE HYDRAULIC PROPERTIES OF SOILS Final Technical Report, 1 Aug. - 30 Sep. 1988
Peter S. Eagleson and Michael F. Jasinski 23 Nov. 1988 10 p
(Grant NAG5-510)
(NASA-CR-183384; NAS 1.26:183384) Avail: NTIS HC A02/MF A01 CSCL 02F

The estimation of the spatially variable surface moisture and heat fluxes of natural, semivegetated landscapes is difficult due to the highly random nature of the vegetation (e.g., plant species, density, and stress) and the soil (e.g., moisture content, and soil hydraulic conductivity). The solution to that problem lies, in part, in the use of satellite remotely sensed data, and in the preparation of those data in terms of the physical properties of the plant and soil. The work was focused on the development and testing of a stochastic geometric canopy-soil reflectance model, which can be applied to the physically-based interpretation of LANDSAT images. The model conceptualizes the landscape as a stochastic surface with bulk plant and soil reflective properties. The model is particularly suited for regional scale investigations where the quantification of the bulk landscape properties, such as fractional vegetation cover, is important on a pixel by pixel basis. A summary of the theoretical analysis and the preliminary testing of the model with actual aerial radiometric data is provided. Author

N89-13824*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE CALIFÓRNIA COOPERATIVE REMOTE SENSING PROJECT Final Report
Christine A. Hlavka and Edwin J. Sheffner (TGS Technology, Inc., Moffett Field, Calif.) Jul. 1988 96 p
(NASA-TM-100073; A-88105; NAS 1.15:100073) Avail: NTIS HC A05/MF A01 CSCL 08B

The USDA, the California Department of Water Resources (CDWR), the Remote Sensing Research Program of the University of California (UCB) and NASA have completed a 4-yr cooperative project on the use of remote sensing in monitoring California agriculture. This report is a summary of the project and the final report of NASA's contribution to it. The cooperators developed procedures that combined the use of LANDSAT Multispectral Scanner imagery and digital data with good ground survey data for area estimation and mapping of the major crops in California. An inventory of the Central Valley was conducted as an operational test of the procedures. The satellite and survey data were acquired by USDA and UCB and processed by CDWR and NASA. The inventory was completed on schedule, thus demonstrating the plausibility of the approach, although further development of the data processing system is necessary before it can be used efficiently in an operational environment. Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N89-13825# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
HEAT TRANSFER AND KINETICS OF A METAL HYDRIDE REACTOR
L. Kit Heung 1988 7 p Presented at the Metal Hydrogen Systems Fundamentals and Applications Conference, Stuttgart, Fed. Republic of Germany, 4 Sep. 1988
(Contract DE-AC09-76SR-00001)
(DE88-012818; DP-MS-87-168-Rev-1; CONF-880969-2-Rev-1)
Avail: NTIS HC A02/MF A01

A 3-inch diameter LaNi4.25Al0.75 reactor was studied for its effective heat transfer coefficient and reaction kinetics. The effective heat transfer coefficient is a strong function of hydrogen pressure in the reactor. The reaction rate is a function of the temperature, the hydrogen pressure and the hydrogen to metal ratio in the solid phase. An unreacted-core reaction model fits the reaction rate data very well. DOE

N89-13826# Commission of the European Communities, Brussels (Belgium).
CONTRACTORS' MEETING AND WORKSHOP ON GEOCHEMISTRY
K. Louwrier, ed. and J. Garnish, ed. 1988 112 p Meeting held in Antwerp, Belgium, 5 Nov. 1986
(DE88-014228; EUR-11362; CONF-8611265) Avail: NTIS (US Sales Only) HC A06

The Commission of the European Communities has been involved in research, development and demonstration of geothermal energy since 1975. Chemistry is an important aspect of this research. It enters at many levels in the process of extracting heat from the sub-soil. Water-rock interaction is important in the Hot Dry rock technology where water is pumped through a man-made fracture system in a rock that has otherwise virtually no water circulation. Natural deep ground waters that are of interest for geothermal developments often contain considerable amounts of salts that may precipitate at lower temperature or pressure. This leads to scaling during the production of hot water or steam. The abatement of scales is of the utmost importance. Proper pressure control and inhibitors can control the precipitation of calcium carbonate. Sulfides and silica however still pose serious problems during the exploitation of geothermal energy, and research on the control of these scales should continue. Certain clastic sediments consist of sandstone containing clay particles. Producing water from or injecting water into such formations may cause these particles to move. This can lead to plugging of the pores and formation of a significant skin. Study of the behavior of these sediments, consolidated or unconsolidated, and of its clays is an important aspect of water-rock interaction. DOE

N89-13827# Sandia National Labs., Albuquerque, N. Mex.
STRAIN GAUGE VALIDATION EXPERIMENTS FOR THE SANDIA 34-METER VAWT (VERTICAL AXIS WIND TURBINE) TEST BED
Herbert J. Sutherland Aug. 1988 44 p
(Contract DE-AC04-76DP-00789)
(DE89-000418; SAND-88-1807) Avail: NTIS HC A03/MF A01

Sandia National Laboratories has erected a research oriented, 34- meter diameter, Darrieus vertical axis wind turbine near Bushland, Texas. This machine, designated the Sandia 34-m VAWT Test Bed, is equipped with a large array of strain gauges that have been placed at critical positions about the blades. This manuscript details a series of four-point bend experiments that were conducted to validate the output of the blade strain gauge circuits. The output of a particular gauge circuit is validated by comparing its output to equivalent gauge circuits (in this stress state) and to theoretical predictions. With only a few exceptions, the difference between measured and predicted strain values for a gauge circuit was found to be of the order of the estimated repeatability for the measurement system. DOE

N89-13828# Sandia National Labs., Albuquerque, N. Mex.
A 31 PERCENT EFFICIENT GaAs/SILICON MECHANICALLY STACKED, MULTIJUNCTION CONCENTRATOR SOLAR CELL
James M. Gee and Gary F. Virshup (Varian Associates, Palo Alto, Calif.) 1988 5 p Presented at the 20th IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 26 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000460; SAND-88-2564; CONF-880965-7) Avail: NTIS HC A02/MF A01

Development and demonstration of a GaAs/silicon mechanically stacked, multi-junction (MSMJ) solar concentrator cell with an efficiency in excess of 30 percent is reported. This is the highest efficiency ever reported for a solar cell and this is the first solar cell to ever achieve an efficiency in excess of 30 percent. Our preliminary analysis suggests that an efficiency approaching 35 percent is possible with GaAs-based MSMJ cells. DOE

N89-13829*# Eagle Engineering, Inc., Houston, Tex.
CONCEPTUAL DESIGN OF A LUNAR BASE SOLAR POWER PLANT LUNAR BASE SYSTEMS STUDY TASK 3.3
14 Aug. 1988 60 p
(Contract NAS9-17878)
(NASA-CR-172086; NAS 1.26:172086; EEI-88-199) Avail: NTIS HC A04/MF A01 CSCL 10B

The best available concepts for a 100 kW Solar Lunar Power Plant based on static and dynamic conversion concepts have been examined. The two concepts which emerged for direct comparison yielded a difference in delivered mass of 35 MT, the mass equivalent of 1.4 lander payloads, in favor of the static concept. The technologies considered for the various elements are either state-of-the-art or near-term. Two photovoltaic cell concepts should receive high priority for development: i.e., amorphous silicon and indium phosphide cells. The amorphous silicon, because it can be made so light weight and rugged; and the indium phosphide, because it shows very high efficiency potential and is reportedly not degraded by radiation. Also the amorphous silicon cells may be mounted on flexible backing that may roll up much like a carpet for compact storage, delivery, and ease of deployment at the base. The fuel cell and electrolysis cell technology is quite well along for lunar base applications, and because both the Shuttle and the forthcoming Space Station incorporate these devices, the status quo will be maintained. Early development of emerging improvements should be implemented so that essential life verification test programs may commence. F.M.R.

N89-13830# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
USABLE ELECTRICITY FROM THE SUN
1988 11 p
(Contract DE-AC02-83CH-10093)
(DE88-001150; DOE/CH-10093/20) Avail: NTIS HC A03/MF A01

The achievements described in this bulletin underscore America's world leadership in photovoltaic products and technology. However, the cost of producing electricity from the sun still remains too high for PV to compete effectively with conventional energy sources in supplying peak power to electric utilities. More technological progress has to be made, to lower the costs of PV systems and components while increasing their efficiency, reliability, and life expectancy. These are the objectives of the National Photovoltaics Program. The National Photovoltaic Program is managed by the Department of Energy (DOE). Recognizing that a healthy and growing photovoltaic industry contributes to a more balanced energy picture for the U.S. DOE's objective is to reduce PV costs to a level that is competitive with other energy sources. Specifically, the program's goal is to improve PV systems to the point where, by the late 1990s, they can be

generating electricity at utility-competitive costs (12 cents/kilowatt-hour by the early 1990s, and 6 cents/kilowatt-hour by the year 2000). With advice from program participants, industry, and the research community, the Photovoltaics Division at DOE establishes long-term technical goals to guide the program to the successful completion of its objectives. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N89-13831*# Old Dominion Univ., Norfolk, Va. Dept. of Chemical Sciences.
OPTIMIZATION OF THE TUNGSTEN OXIDE TECHNIQUE FOR MEASUREMENT OF ATMOSPHERIC AMMONIA Final Report, period ending 31 Oct. 1987
Kenneth G. Brown Dec. 1987 11 p
(Contract NAS1-17993)
(NASA-CR-181509; NAS 1.26:181509) Avail: NTIS HC A03/MF A01 CSCL 04A

Hollow tubes coated with tungstic acid have been shown to be of value in the determination of ammonia and nitric acid in ambient air. Practical application of this technique was demonstrated utilizing an automated sampling system for in-flight collection and analysis of atmospheric samples. Due to time constraints these previous measurements were performed on tubes that had not been well characterized in the laboratory. As a result the experimental precision could not be accurately estimated. Since the technique was being compared to other techniques for measuring these compounds, it became necessary to perform laboratory tests which would establish the reliability of the technique. This report is a summary of these laboratory experiments as they are applied to the determination of ambient ammonia concentration. Author

N89-13832# California Univ., Riverside. Statewide Air Pollution Research Center.
ATMOSPHERIC PHOTOCHEMICAL MODELING OF TURBINE ENGINE FUELS AND EXHAUSTS. COMPUTER MODEL DEVELOPMENT, VOLUME 1 Final Report, Oct. 1984 - Dec. 1986
William O. Carter, Arthur M. Winer, Roger Atkinson, Susan E. Heffron, and Minn P. Poe May 1988 260 p
(Contract F08635-C-80-0359)
(AD-A198690; AFESC/ESL-TR-87-35-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 04A

A computer model capable of predicting photochemical reactivity of turbine engine fuel emissions and exhaust emissions from routine AF operations is developed. This Phase 2 report describes experimental work on engine exhaust components conducted in environmental chamber facilities. The results indicate that engine exhaust is significantly more reactive than the fuels themselves. The reaction mechanism incorporates new methods for lumping of complex reactive organic gas (ROG) mixtures when representing them in model simulations. This technical report is divided into two volumes. Volume 1 explains the computer model development, while Volume 2 is the User's Manual. GRA

N89-13833# California Univ., Riverside. Statewide Air Pollution Research Center.
ATMOSPHERIC PHOTOCHEMICAL MODELING OF TURBINE ENGINE FUELS AND EXHAUSTS. COMPUTER MODEL DEVELOPMENT, VOLUME 2 Final Report, Oct. 1984 - Dec. 1986
William O. Carter, Arthur M. Winer, Roger Atkinson, Susan E. Heffron, and Minn P. Poe May 1988 210 p
(Contract F08635-C-80-0359)
(AD-A198691; AFESC/ESL-TR-87-35-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 04A

This User's Manual documents how to use an atmospheric photochemical reactivity modeling software system which has been developed for the U.S. Air Force under this contract. The modeling software can be used to conduct floating box type airshed model simulations to determine the air quality impacts of many types of reactive organic gases (ROG) emitted under a variety of air pollution scenarios. GRA

N89-13834# Lawrence Livermore National Lab., Calif.
THE EVALUATION OF EMERGENCY RESPONSE TRACE GAS AND DENSE GAS DISPERSION MODELS
M. H. Dickerson and D. L. Ermak Aug. 1988 49 p Presented at the American Meteorological Society Topical Meeting, Charleston, S.C., 25 Sep. 1988
(Contract W-7405-eng-48)
(DE88-015447; UCRL-99348; CONF-8809120-1) Avail: NTIS HC A03/MF A01

The evaluation of atmospheric dispersion models has been an active concern of the atmospheric science community for the past two decades. During this period, investigators were principally interested in how well an air quality model simulated the dispersion of trace gas emission. Interest in the evaluation of heavier-than-air vapor dispersion models is a more recent development. A variety of statistical techniques and other measures for assessing the performance of air quality models have been proposed. This paper presents a review of these methods, which have been met with both acceptance and criticism within the scientific community, and proposes additional methodologies, especially geared toward the evaluation of real-time accident response models. Since the emergency response manager (ERM) is the one who uses the assessment generated by these models, the major focus of the ideas discussed revolve around the needs and requirements of the ERM. DOE

N89-13835# Oak Ridge National Lab., Tenn. Energy and Economic Analysis Section.
TROPOSPHERIC OZONE AND VEHICULAR EMISSIONS
Milton Russell (Tennessee Univ., Knoxville.) Jun. 1988 30 p Presented at the National Academy of Engineering Inaugural Symposium, Irvine, Calif., 11 May 1988
(Contract DE-AC05-84OR-21400)
(DE88-015562; CONF-8805183-1) Avail: NTIS HC A03/MF A01

The paper examines changes in the transportation system as a means of reducing tropospheric ozone in the South Coast Air Basin of California. It takes this issue as a paradigm for the broader national situation where there are environmental risks for which no plausible, politically or economically acceptable remedies exist. It summarizes the health risks of ozone, the current and prospective levels of control required to avoid them, the prospective contribution of transportation controls, and the information required to put the issue in a social benefits and costs framework for decision. DOE

N89-13836# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
LANDSCAPE PATTERN AND THE SPREAD OF DISTURBANCE
Monica G. Turner, Robert H. Gardner, Virginia H. Dale, and Robert V. ONeill 1988 14 p Presented at the 8th International Symposium of Problems of Landscape Ecological Research, Bratislava, Czechoslovakia, 3 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE88-007069; CONF-881047-1) Avail: NTIS HC A03/MF A01

Landscape ecology seeks to understand the effects of spatial heterogeneity on ecological processes at broad spatial scales. Disturbance can be defined as any relatively discrete event in time that disrupts ecosystem community, or population structure and changes resources, substrate availability, or the physical environment. The spread of disturbance across a landscape is an important example of a functional characteristic that is influenced by landscape heterogeneity. Few studies have been done on the relationship between landscape pattern and disturbance. Landscape heterogeneity may enhance or retard the spread of disturbance, and disturbances may generate landscape patterns. However, a general theory to predict the effects of landscape

pattern on disturbance propagation has not yet emerged. This paper presents a conceptual framework for studying the effect of landscape pattern on the spread of disturbance. Generalizations are then developed from simulation experiments based on percolation theory. DOE

N89-13837# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
NOAA (NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION) KING AIR AIRBORNE DATA ACQUISITION SYSTEM: DESCRIPTION AND USER'S GUIDE
S. W. Wilkison and J. F. Boatman Jul. 1988 85 p
(PB88-243936; NOAA-TM-ERL-ARL-164) Avail: NTIS HC A05/MF A01 CSCL 13B

The National Oceanic and Atmospheric Adm. (NOAA) Air Quality Group uses a reliable and rugged real time data acquisition system aboard the NOAA King Air research aircraft. Descriptions of the hardware and software used within the system are presented. In-house software was written to display the real time data on screen of an Advanced Technology compatible personal computer. A user's guide for this software is included, as well as listings of the routines used in the main program for the data acquisition system. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N89-13838 Illinois Univ., Urbana-Champaign.
AN INVESTIGATION OF THE GENERAL CIRCULATION ASSOCIATED WITH EXTREME ANOMALIES IN HEMISPHERIC MEAN ATMOSPHERIC MASS Ph.D. Thesis
John Raymond Christy 1987 216 p
Avail: Univ. Microfilms Order No. DA8803001

Significant events in terms of hemispheric mass anomalies are identified using surface data from the European Centre for Medium-Range Weather Forecasts (ECMWF) for 1979-1982. The time scale of the anomalous fluctuations in hemispheric mean atmospheric mass is found to have considerable variance in the 30 to 80 day period band. The horizontal mass distribution reveals that significant events in hemispheric mean mass are accompanied by a significant increase in the presence of extreme localized stationary surface anomalies in the mid and upper latitudes of both hemispheres. The implication is that extreme cases of localized anomalies in the mass field are dependent to some degree on the global distribution of mass. An analysis of the ECMWF pressures is performed by means of standard and complex empirical orthogonal functions (EOF). The zonal mean circulation is examined for northern winter and differences between events of excessive hemispheric mass and deficient mass are found. Significant differences in the midlatitude circulation are also detected during periods of anomalous hemispheric mean atmospheric mass. The results from anomalies in geopotential height and poleward heat fluxes point to the equivalent barotropic nature of the regional perturbations that occur in association with hemispheric mass anomalies. Dissert. Abstr.

N89-13839 Brunel Univ., Uxbridge (England).
THE QUALITY OF FIBRE REINFORCED THERMOPLASTICS MOULDINGS Ph.D. Thesis
Hugh Adrian Potts 1987 362 p
Avail: Univ. Microfilms Order No. BRDX81180

The requirement for injection molded short carbon fiber reinforced thermoplastics in helicopter applications is based on component coat and weight savings. The presence of short fibers in a thermoplastic polymer can exert a significant influence upon the rheological properties of the melt. As it is the rheology of the material which determines melt flow performance and hence the flow-induced fiber orientation in the final molded part, accurate data are required to understand and predict polymer flow. Although standard procedures exist for determining the rheological characteristics of melts, their relevance to the injection modling proscess was questioned. Consequently, a high shear rate rheometer was developed, and the results for the filled and unfilled melts compared with the standard equipment. Significant effects involving thermal conductivity and fiber breaking were identified which leads to errors in the data produced using the standard device. Two techniques using reflected light and thermal imaging were successfully developed for the characterization of the orientation of short carbon fibers in injection molded parts. Welds are a common feature in injection molded parts. This study also addresses the problem of the knit weld in a specially designed test specimen. Applying fracture mechanics principles, the integrity of the welded structure was analyzed, and the results correlated with microstructural observations. Finally, impact studied using subcomponent geometries have addressed the effects of flow induced fiber orientation in specific geometrical features.
Dissert. Abstr.

N89-13840# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 525, MAY 1988. PART 1: (PROMPT REPORTS). DATA FROM APRIL 1983, MARCH 1988 AND LATE DATA
Helen E. Coffey, ed. and John A. McKinnon, ed. May 1988 157 p
(Contract N00014-86-F-0049)
(PB88-236518; SGD-525-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A08/MF A01 CSCL 04A

A detailed index is presented for 1987 and 1988 solar geophysical data. Data for April 1988 includes: IUWDS alert periods (advance and world wide), solar activity indices, solar flares, solar radio emission and Stanford mean solar magnetic field. Data for March 1988 includes: Solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitors, geomagnetic indices, and radio propagation indices. Late data includes: Pioneer 12 solar wind for February 1984 and Calcium plage data for December 1987.
Author

N89-13841# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 525, MAY 1988. PART 2: (COMPREHENSIVE REPORTS). DATA FOR NOVEMBER 1987 AND MISCELLANEA
Helen E. Coffey, ed. and John A. McKinnon, ed. May 1988 98 p
(Contract N00014-86-F-0049)
(PB88-237003; SGD-525-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A05/MF A01 CSCL 04A

A detailed index is presented of solar geophysical data for 1987 and 1988. Data for November 1987 includes: Meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar X-ray radiation from GOES satellite, mass ejections from the sun, and active prominences and filaments. Miscellaneous data includes: interplanetary solar particles and plasma, IMP 8 solar wind from October 1987 to January 1988 and IMP solar particles from September 1985 to May 1986. Author

N89-13842*# Johns Hopkins Univ., Baltimore, Md. Dept. of Earth and Planetary Sciences.
CONSTRAINTS ON GRAVITY WAVE INDUCED DIFFUSION IN THE MIDDLE ATMOSPHERE
Darrell F. Strobel Feb. 1988 24 p
(Grants NAG5-796; NAGw-826)
(NASA-CR-183383; NAS 1.26:183383) Avail: NTIS HC A03/MF A01 CSCL 04A

A review of the important constraints on gravity wave induced diffusion of chemical tracers, heat and momentum is given. Ground-based microwave spectroscopy measurements of H2O and CO and rocket-based mass spectrometer measurements of Ar constrain the eddy diffusion coefficient for constituent transport (K sub zz) to be (1-3) x 10 to the 5th sq cm/sec in the upper mesosphere. Atomic oxygen data also limits K sub zz to a

comparable value in the mesopause. From the energy balance of the upper mesosphere the eddy diffusion coefficient for heat transport (D sub H) is, at most, 6 x 10 to the 5th sq cm/sec at the mesopause and decreasing substantially with decreasing altitude. The available evidence for mean wind deceleration and the corresponding eddy diffusion coefficient for momentum stresses (D sub M) suggests that it is at least 1 x 10 to the 6th sq cm/sec in the upper mesosphere. Consequently the eddy Prandtl number for macroscopic scale lengths is greater than 3. Author

N89-13843*# California Inst. of Tech., Pasadena. Seismological Lab.

DRIVING FORCES: SLAB SUBDUCTION AND MANTLE CONVECTION

Bradford H. Hager [1988] 14 p

(Grant NAG5-842)

(NASA-CR-183404; NAS 1.26:183404) Avail: NTIS HC A03/MF A01 CSCL 08G

Mantle convection is the mechanism ultimately responsible for most geological activity at Earth's surface. To zeroth order, the lithosphere is the cold outer thermal boundary layer of the convecting mantle. Subduction of cold dense lithosphere provides tha major source of negative buoyancy driving mantle convection and, hence, surface tectonics. There are, however, importnat differences between plate tectonics and the more familiar convecting systems observed in the laboratory. Most important, the temperature dependence of the effective viscosity of mantle rocks makes the thermal boundary layer mechanically strong, leading to nearly rigid plates. This strength stabilizes the cold boundary layer against small amplitude perturbations and allows it to store substantial gravitational potential energy. Paradoxically, through going faults at subduction zones make the lithosphere there locally weak, allowing rapid convergence, unlike what is observed in laboratory experiments using fluids with temperature dependent viscosities. This bimodal strength distribution of the lithosphere distinguishes plate tectonics from simple convection experiments. In addition, Earth has a buoyant, relatively weak layer (the crust) occupying the upper part of the thermal boundary layer. Phase changes lead to extra sources of heat and bouyancy. These phenomena lead to observed richness of behavior of the plate tectonic style of mantle convection. Author

N89-13844# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANOMALIES OF THE IONOSPHERIC F2-LAYER ABOVE GUANGZHOV REGION

Huang Qingming 21 Jul. 1988 11 p Transl. into ENGLISH from Kongjian Kexue Xuebao (Peoples Republic of China), v. 7, no. 2, Apr. 1987 p 134-138

(AD-A198716; FTD-ID(RS)T-0394-88) Avail: NTIS HC A03/MF A01 CSCL 04A

The Guangzhou Ionospheric Observatory is located near the geomagnetic equator (geomagnetic coordinates; 183.0, E; 11.5, N), According to the analysis of ionospheric data from 18 observatories, Guangzhou is situated at the north crest of the double-crest where F-2 reaches its maximum value. During high solar activity years, the maximum value of F-2 occurs even at night time. In addition, the occurring frequency of the ionospheric disturbances is higher than that at other observatories in the country. These characteristics are all considered equatorial anomaly phenomena of the F-2 layer. GRA

N89-13845*# Naval Research Lab., Washington, D.C. Plasma Physics Div.

SIMULATION OF ELECTROSTATIC MODES IN A MAGNETOPLASMA WITH TRANSVERSE INHOMOGENEOUS ELECTRIC FIELD

K.-I. Nishikawa, G. Ganguli, Y. C. Lee (Maryland Univ., College Park.), and P. J. Palmadesso 31 May 1988 38 p Sponsored by NASA, Washington, D.C.

(NASA-CR-183242; NAS 1.26:183242; AD-A198823; NRL-MR-6206) Avail: NTIS HC A03/MF A01 CSCL 20I

Ion cyclotron turbulence has been observed with shocks and double layers in the magnetosphere where strongly localized electric fields perpendicular to the magnetic field are present. Theoretical analysis suggests that electrostatic waves with frequency of the order of the ion cyclotron frequency can be destabilized due to the coupling of regions of positive and negative energy ion waves. The nonlocal theory for a smooth profile of transverse inhomogeneous electric fields shows that localized ion waves grow in the region where the electric fields are present. Using a spatially two-dimensional electrostatic code, we investigate this instability in plasma conditions characterized by a localized transverse electric field of width L is dominated by L sub x, where L sub x is the simulation length in the x-direction; and distinguish it from the transverse kinetic Kelvin Helmholtz instability. The simulation results show that the growing ion waves are associated with small vortices at the linear stage, which evolve into a nonlinear stage dominated by larger vortices with lower frequencies. GRA

N89-13846# Norwegian Defence Research Establishment, Kjeller.

DYNAMICS OF THE POLAR MESOPAUSE AND LOWER THERMOSPHERE REGION AS OBSERVED IN THE NIGHT AIRGLOW EMISSIONS

Hans Kristian Myrabo Feb. 1988 103 p

(AD-A198889; NDRE-PUBL-88/1001; ISSN-0800-4412) Avail: NTIS HC A06/MF A01 CSCL 04A

This work utilizes night airglow emissions to deduce temperatures, dynamics, energetics, transport and photochemistry of the polar 80 to 110 km atmospheric region. The morphological behavior of this region as seen in the night airglow emissions is best described by quasi regular to regular variations in the temperature and in the intensities of the emissions with periods ranging from minutes to a few days. Temperature amplitudes are seen from a few degrees up to + or - 50 K. Intensity changes up to several hundred percent may occur. Gravity waves from below are generally found to be present in the region, being responsible for much of the short period variations. The long period variations are seen to be related to circulation changes in the lower atmosphere. Stratospheric warmings are generally associated by a cooling of the 80 to 110 km region by a ratio approximately twice as large in amplitude as the heating at the 10 mbar level. The semidiurnal tide is found to be dominant with a peak to peak amplitude of about 5 K, in contrast to model calculations. Effects from geomagnetic phenomena on the energetics and dynamics of the region are not seen, and if present, have to be small or rare as compared to the influence from below. There is a mesopause temperature maximum at winter solstice. Pronounced differences in the day to day and seasonal behavior of the odd oxygen associated nightglows at the North and South Pole are found. GRA

N89-13847# Textron Bell Aerospace Co., Buffalo, N. Y.

MOVING BASE GRAVITY GRADIOMETER SURVEY SYSTEM (GGSS) PROGRAM Final Report, Mar. 1983 - Apr. 1988

Louis Pfohl, Walter Rusnak, Albert Jircitano, and Andrew Grierson Apr. 1988 246 p

(Contract F19628-83-C-0052)

(AD-A198956; AFGL-TR-88-0126) Avail: NTIS HC A11/MF A01 CSCL 08E

The GGSS program began in early 1983 with the objective of delivering a landmobile and airborne system capable of fast, accurate, and economical gravity gradient surveys of large areas anywhere in the world. The objective included the development and use of post-mission data reduction software to process the survey data into solutions for the gravity disturbance vector components (north, east and vertical). This document describes the GGSS equipment hardware and software, integration and lab test procedures and results, and airborne and land survey procedures and results. Included are discussions on test strategies, post-mission data reduction algorithms, and the data reduction processing experience. Perspectives and conclusions are drawn from the results. GRA

N89-13848# Colorado Univ., Boulder. Dept. of Astrophysical Planetary and Atmospheric Sciences.
STRATOSPHERIC CONSTITUENT RESPONSE TO VERTICALLY PROPAGATING EQUATORIAL WAVES Final Report, 1 Mar. 1986 - 29 Feb. 1988
Murry L. Salby 29 Feb. 1988 17 p
(Contract N00014-86-K-0151)
(AD-A199068) Avail: NTIS HC A03/MF A01 CSCL 04B

Planetary-scale equatorial waves play an important role in the dynamics of the tropical atmosphere. They are believed to be excited in unsteady convective heating in the tropical troposphere. From convective centers in the intertropical convergence zone (ITCZ), equatorial waves propagate vertically into the upper atmosphere where they are eventually absorbed, e.g., through radiative dissipation. A spectrum of vertically propagating Kelvin waves was revealed to be trapped about the equator, radiating vertically out of the tropical troposphere. Two other Kelvin waves were found with phase velocities 2 and 4 times as fast. The ultrafast Kelvin waves move at nearly 120 m/s and are seen to propagate to the highest altitude observed by Nimbus-7 LIMS. Each class has the form of a Kelvin wave, a Gaussian centered on the equator and propagating vertically, and all satisfy the dispersion relationship for equatorial Kelvin waves. These vertically propagating Kelvin waves account for a substantial fraction of the temperature variability in the tropical stratosphere. In combination, they lead to temperature fluctuations in excess of 5K in the upper stratosphere and mesosphere. Because several chemical constituents are photochemically controlled in this region, vertically propagating Kelvin waves are expected to lead to variations in the abundances of such species. GRA

N89-13849# Sandia National Labs., Albuquerque, N. Mex.
THE DESIGN, CONSTRUCTION AND OPERATION OF A PHYSICAL SIMULATOR FOR EVALUATING GEOPHYSICAL ELECTRICAL TECHNIQUES
Thomas C. Bickel and Paul J. Hommert 1988 12 p Presented at the 58th Society of Exploration Geophysicists Annual Meeting, Anaheim, Calif., 30 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-011252; SAND-88-1494C; CONF-881018-1) Avail: NTIS HC A03/MF A01

A laboratory facility has been constructed for studying DC and very low frequency geophysical methods. This facility will be used to evaluate geophysical electrical methods that have the potential to spacially map fossil energy recovery processes and delineate reservoir heterogeneities. The physical simulator, an electrolytic tank slightly more than one meter in diameter, was built with a unique treatment of individual elements, where each element is electrically isolated from adjacent elements. Design calculations and operational data validate that by minimizing boundary effects, this approach results in a threefold increase in the model size that can be used in the tank. This approach will also permit scale model layering studies, a phenomenon which has often frustrated field application of DC electrical methods. The facility is being used to validate inversion models for surface DC methods and to study alternative geometries involving either downhole current injection or potential measurement. DOE

N89-13850# International Atomic Energy Agency, Vienna (Austria).
METHODOLOGY AND PROCEDURES FOR COMPILATION OF HISTORICAL EARTHQUAKE DATA. REPORT OF A CONSULTANTS MEETING HELD IN LONDON, 18-21 MARCH 1986
Oct. 1987 45 p Meeting held in London, United Kingdom, 18 Mar. 1986
(DE88-703830; IAEA-TECDOC-434; CONF-8603250) Avail: NTIS (US Sales Only) HC A03/MF A01

This report was prepared subsequent to the recommendations of the project initiation meeting in Vienna, November 25 to 29, 1985, under the IAEA Interregional project INT/9/066 Seismic Data for Nuclear Power Plant Siting. The aim of the project is to co-ordinate national efforts of Member States in the Mediterranean region in the compilation and processing of historical earthquake data in the siting of nuclear facilities. The main objective of the document is to assist the participating Member States, especially those who are initiating an NPP siting programme, in their effort to compile and process historical earthquake data and to provide a uniform interregional framework for this task. Although the document is directed mainly to the Mediterranean countries using illustrative examples from this region, the basic procedures and methods herein described may be applicable to other parts of the world such as Southeast Asia, Himalayan belt, Latin America, etc. DOE

N89-13851*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DETERMINATION OF SPECTROSCOPIC PROPERTIES OF ATMOSPHERIC MOLECULES FROM HIGH RESOLUTION VACUUM ULTRAVIOLET CROSS SECTION AND WAVELENGTH MEASUREMENTS Semiannual Status Report No. 8, 1 May - 31 Oct. 1988
W. H. Parkinson, K. Yoshino, and D. E. Freeman Nov. 1988 13 p
(Grant NAG5-484)
(NASA-CR-184601; NAS 1.26:184601) Avail: NTIS HC A03/MF A01 CSCL 04A

Progress is given on work on: cross section measurements in the transmission window regions of the Schumann-Runge bands of oxygen; the determinations of predissociation linewidths; the theoretical calculation of band oscillator strengths of the Schumann-Runge absorption bands of O-16O-18; the determination of molecular spectroscopic constants; and the combined Herzberg continuum cross sections. The experimental investigations relevant to the cross section measurements, predissociation linewidths, and molecular spectroscopic constants are effected at high resolution with a 6.65 m scanning spectrometer which is, by virtue of its small instrumental width (FWHM = 0.0013 nm), suitable for cross section measurements of molecular bands with discrete rotational structure. Such measurements are needed for accurate calculations of the stratospheric production of atomic oxygen and heavy ozone formed following the photo-predissociation of O-16O-18 by solar radiation penetrating between the absorption lines of O-16(sub 2). Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N89-13852*# Wisconsin Univ., Madison. Cooperative Inst. for Meteorological Satellite Studies.
AN INVESTIGATION OF THE ROLE OF CURRENT AND FUTURE REMOTE SENSING DATA SYSTEMS IN NUMERICAL METEOROLOGY Final Report, 28 Sep. 1987 - 30 Jul. 1988
George R. Diak Oct. 1988 10 p
(Contract NCC8-11)
(NASA-CR-180461; NAS 1.26:180461) Avail: NTIS HC A02/MF A01 CSCL 04B

The question of the potential impact of the Advanced Microwave Sounding Units (AMSU) on numerical analyses and forecasts and what advantages it will have over its predecessor the Microwave Sounding Unit (MSU) are addressed. Author

N89-13853# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
CROSSWIND PROFILER MODEL 2
G. R. Ochs, J. J. Wilson, S. Abbott, and R. George Mar. 1988 63 p
(Contract IAR-6-87109)
(PB88-229679; NOAA-ERL-WPL-152) Avail: NTIS HC A04/MF A01 CSCL 04B

An optical instrument is described that measures the crosswind simultaneously at five locations along optical paths from 200 m to 1.5 km. Author

N89-13854# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ANALYSIS OF TEMPERATURE AND VELOCITY MICROTURBULENCE PARAMETERS FROM AIRCRAFT DATA AND RELATIONSHIP TO ATMOSPHERIC REFRACTIVE INDEX STRUCTURE M.S. Thesis
Elizabeth A. Beecher May 1988 180 p
(AD-A196542; AFIT/CI/NR-88-20) Avail: NTIS HC A09/MF A01 CSCL 04B

Due to inherent turbulence, the atmosphere has a temporally and spatially variable refractive index, which degrades propagating electromagnetic radiation. (C sub n)sq is a key parameter for describing refractive variations. Data was analyzed from several instruments involved in an electro-optics/meteorology experiment; scintillometer; thermosonde; radar vertical profiler, and instrumented aircraft. The aircraft measured (C sub T) sq and (C sub u) sq using hot and cold wire sensors and FM recording apparatus. The taped data was processed via FFT to produce one-dimensional variance spectra (wavenumber range 0.01 to 10/m). Flights usually produced a 10 km vertical profile processed to give roughly 0.5 km resolution. Spectral editing was based on regression analysis fit to -5/3 frequency dependence. A majority of spectra showed the classic inertial subrange. (C sub n) sq and epsilon were calculated from (C sub T) sq and (C sub u) sq, respectively. In active regions, the following relationship can be derived. (C sub T) sq((C sub u) sq. = 1.6 R sub i)(P sub r - R sub i) (theta/g) (delta theta/delta z). GRA

N89-13855# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
SUMMARY OF 1988 ATLANTIC TROPICAL CYCLONE ACTIVITY AND VERIFICATION OF AUTHOR'S SEASONAL FORECAST
William M. Gray 28 Nov. 1988 49 p
Avail: NTIS HC A03/MF A01

The tropical cyclone (TC) activity which occurred in the Atlantic Basin during 1988 is summarized, and the author's seasonal forecast of TC activity that was issued in late May is verified. This forecast was based on the author's previous research and new research which relates seasonal Atlantic hurricane activity to: (1) the El Nino; (2) the Quasi-Biennial Oscillation of equatorial 30 mb and 50 mb stratospheric winds; (3) Caribbean Basin-Gulf of Mexico Sea Level Pressure Anomaly in spring and early summer; and (4) lower latitude Caribbean Basin 200 mb zonal wind anomaly in June and July in non-El Nino seasons. Author

N89-13856# Wisconsin Univ., Madison. Dept. of Meteorology.
CAT (CLEAR AIR TURBULENCE) FORECASTING USING TRANSILIENT TURBULENCE THEORY Scientific Report No. 1, 20 Feb. 1987 - 20 Feb. 1988
William H. Raymond and Roland B. Stull 20 Feb. 1988 29 p
(Contract F19628-87-K-0035)
(AD-A198768; AFGL-TR-88-0106) Avail: NTIS HC A03/MF A01 CSCL 04B

A transilient turbulence parameterization has been inserted into the regional 3-D mesoscale numerical model. Transilient turbulence parameterizes both boundary layer and clear air turbulence (CAT). The new transilient turbulence scheme replaces separate formulations of the boundary layer parameterization, dry convective adjustment, cumulus parameterization and horizontal diffusion. A new surface layer flux formulation that is compatible with the transilient turbulence parameterization has also been installed. A sixth order implicit tangent filter has been inserted to remove numerical noise. This separation of the turbulence physics from numerical stability considerations gives us an opportunity to examine the mixing process in greater detail. Forecasts are compared from the revised model with the standard model formulation, which has a Blackadar boundary layer and fourth order K theory horizontal diffusion. Forecasts using both Kuo cumulus parameterization and explicit cloud convective representations have been made with this standard model utilizing the OSCAR IV data set. Comparisons between the control and the transilient turbulence approach are used to highlight the role of turbulence and its affect on the overall forecast. Verifying station radiosonde reports and analysis are the final authority on the accuracy of the forecasts. Early results suggests that some positive benefits will occur in the boundary layer forecasts once it is tuned to the surface flux. GRA

N89-13857# National Severe Storms Forecast Center, Kansas City, Mo.
SEVERE LOCAL STORM WARNING VERIFICATION: 1987 Final Report
Leo A. Grenier, John T. Halmstad, and Preston W. Leftwich, Jr. Jun. 1988 27 p
(PB88-241393; NOAA-TM-NWS-NSSFC-20) Avail: NTIS HC A03/MF A01 CSCL 04B

Tornado and severe thunderstorm warnings are issued by local offices of the National Weather Service. Routine verification of these warnings is accomplished at the National Severe Storms Forecast Center. The verification procedures are highlighted and the national, regional and local verification results for the year 1987 are summarized. Stations in the Central and Southern regions again issued most of the warnings and experienced most of the severe local storm events. On a national scale, verification scores showed mixed results. Continued improvement in the False Alarm Ratio and the Critical Success Index are evident with a slight decrease in the Probability of Detection. Author

N89-13858*# National Academy of Sciences - National Research Council, Washington, D. C. Panel on Meteorological Support for Space Operations.
METEOROLOGICAL SUPPORT FOR SPACE OPERATIONS: REVIEW AND RECOMMENDATIONS Final Report
1988 88 p
(Contract NASw-4272)
(NASA-CR-183015; NAS 1.26:183015; PB88-246376) Avail: NTIS HC A05/MF A01 CSCL 04B

The current meteorological support provided to NASA by NOAA, Air Weather Service, and other contractors is reviewed and suggestions are offered for its improvement. These recommendations include improvement in NASA's internal management organizational structure that would accommodate continued improvement in operational weather support, installation of new observing systems, improvement in analysis and forecasting procedures, and the establishment of an Applied Research and Forecasting Facility. Author

N89-13859# International Centre for Theoretical Physics, Trieste (Italy).
MICROPHYSICS OF THE SAHARAN DUST AND ITS IMPLICATIONS ON CLIMATE
A. E. Kalu Dec. 1987 44 p Presented at the 2nd Workshop on Cloud Physics and Climate, Trieste, Italy, 23 Nov. - 18 Dec. 1987
(DE88-703525; IC-87/419) Avail: NTIS (US Sales Only) HC A03/MF A01

A strong influence of Saharan dust plumes on the microphysics of cumulus clouds, especially along their long-distance transport trajectories into cloudy regions of the world, has been discussed and illustrated. This climate-related influence is primarily based on the observed anhydrous non-hygroscopic property of the Saharan dust, otherwise known as the Harmattan dust haze in Nigeria. An observational feature of the dust-cloud interaction which is strongly climate-related is the rapid clearance of cumulus clouds on arrival of a dust plume. This is because aeolian dust particles and water droplets cannot coexist comfortably. A useful practical application of this influence of the dust on clouds by means of atmospheric teleconnection principles for fine-weather prediction in cloudy remote regions seasonally affected by dust plumes from the Sahara, has therefore been suggested. DOE

N89-13924# Colorado State Univ., Fort Collins.
SIMULATION OF RADAR AND SURFACE MEASUREMENTS OF RAINFALL
V. Chandrasekar and V. N. Bringi *In its* Computer Science and

Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 183-19 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N89-13860# National Oceanic and Atmospheric Administration, Seattle, Wash. Environmental Lab.
OCEANOGRAPHIC CONDITIONS ON THE NORTHERN BERING SEA SHELF, 1984-1985
S. Salo, R. D. Muench, and J. D. Schumacher May 1988 60 p (PB88-231758; NOAA-TM-ERL-PMEL-80) Avail: NTIS HC A04/MF A01 CSCL 08C

Data presented were amassed as part of an experiment entitled the Artic Polynya Experiment (APEX). The purpose of the experiment was to study mesoscale processes associated with ice formation in the polynya south of St. Lawrence Island, in the northern Bering Sea. Data were obtained from nine moorings containing seventeen current meters which were deployed near the island and in Bering Strait during October and November, 1984. The records from these instruments were analyzed, and their statistical properties, spectra, and time series comparisons among the records are presented. In addition, data are compared to time series of local winds derived from surface level pressure fields. Author

N89-13861*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASA SEA ICE AND SNOW VALIDATION PROGRAM FOR THE DMSP SSM/I: NASA DC-8 FLIGHT REPORT
D. J. Cavalieri Sep. 1988 145 p
(NASA-TM-100706; Rept-88B0262; NAS 1.15:100706) Avail: NTIS HC A07/MF A01 CSCL 08C

In June 1987 a new microwave sensor called the Special Sensor Microwave Imager (SSM/I) was launched as part of the Defense Meteorological Satellite Program (DMSP). In recognition of the importance of this sensor to the polar research community, NASA developed a program to acquire the data, to convert the data into sea ice parameters, and finally to validate and archive both the SSM/I radiances and the derived sea ice parameters. Central to NASA's sea ice validation program was a series of SSM/I aircraft underflights with the NASA DC-8 airborne Laboratory. The mission (the Arctic '88 Sea Ice Mission) was completed in March 1988. This report summarizes the mission and includes a summary of aircraft instrumentation, coordination with participating Navy aircraft, flight objectives, flight plans, data collected, SSM/I orbits for each day during the mission, and lists several piggyback experiments supported during this mission. Author

N89-13862# Naval Postgraduate School, Monterey, Calif.
A NUMERICAL STUDY OF EDDY INTERACTIONS WITH A BAROTROPIC OCEANIC JET M.S. Thesis
George P. Davis, Jr. Jun. 1988 63 p
(AD-A198818) Avail: NTIS HC A04/MF A01 CSCL 08C

Mesoscale vortices generated by western boundary currents are well observed and documented, particularly in the case of the Gulf Stream System. The movement of these rings in the region of the Gulf Stream is well studied and has been ascribed to the following physical mechanisms: (1) the beta effect on an isolated ring, (2) advection of a ring in a recirculation regime, (3) downstream advection of a ring in contact with a jet, and (4) vorticity advection associated with the jet and eddy interaction. Utilizing a two layer, nonlinear primitive equation model, an examination of eddy movement is conducted, with focus on eddy/jet interaction. A series of numerical experiments is performed in which the initial separation distance between eddy and jet is varied. The model demonstrates that vortex movement is strongly related to the proximity of the vortex to the jet. It also is demonstrated that observed movement is not solely dependent on the beta effect nor on advection due to recirculation. GRA

N89-13863# Massachusetts Inst. of Tech., Cambridge.
EVALUATION OF GEOSAT (GEODETIC SATELLITE) DATA AND APPLICATION TO VARIABILITY OF THE NORTHEAST PACIFIC OCEAN M.S. Thesis
Jeffrey William Campbell Sep. 1988 161 p Prepared in cooperation with Woods Hole Oceanographic Inst., Mass.
(AD-A198950) Avail: NTIS HC A08/MF A01 CSCL 08E

Part of the N.E. Pacific was studied to evaluate and use altimetric data from the Navy Geodetic Satellite GEOSAT. The zero-order accuracy of the major GEOSAT geophysical data record (GDR) channels was verified, and occasional gaps in the altimeter coverage were noted. GEOSAT's 17-day repeat orbit allowed use of collinear-track processing to create profiles of the difference between the sea surface height along a given satellite repeat, and the mean sea surface height along that repeat's groundtrack. Detrending of sea surface bias and tilt on each repeat reduced orbit and other long wavelength errors in the difference profiles. Corrections provided on the GEOSAT GDR were examined for their effects on the difference profiles of three test arcs. It was found that only the ocean tide, electromagnetic bias, and inverted barometer corrections varied enough over the arc lengths (approx. 4400 km) to have any noticeable effect on the difference profiles. Only the ocean tide correction was accurate enough to warrant using it to adjust the sea surface heights. data for the area included making the ocean tide correction, three-point block averaging successive sea surface heights, and forming the mean height profiles from 18 repeat cycles (to reduce aliasing of the M2 tidal component), A set of difference profiles for one GEOSAT arc indicated that a reasonable estimate of GEOSAT's system precision was approx. 4.5 cm (RMS). The mid wavelength range (100 to 500 km) of these profiles was found to be the only range in which oceanic mesoscale features could be separated from altimeter errors. GRA

N89-13864# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
THE IMPACT OF SATELLITE INFRARED SEA SURFACE TEMPERATURES ON THE FNOC (FLEET NUMERICAL OCEANOGRAPHY CENTER) EOTS (EXPANDED OCEAN THERMAL STRUCTURE) REGIONAL GULF STREAM ANALYSIS Final Report
Douglas A. May and Jeffrey D. Hawkins Jul. 1988 18 p
(AD-A198965; NORDA-183) Avail: NTIS HC A03/MF A01 CSCL 08C

In July 1987, two Expanded Ocean Thermal Structure (EOTS) analysis runs were made daily at 12Z for 5 consecutive days. These runs were made offline at the FNOC for the ENOTS Gulf Stream region. All available satellite multichannel sea surface temperature (MCSST) retrievals, ship reports, and expendable bathythermograph observations were assimilated into the first analysis, with MCSSTs withheld from the second to determine satellite data impact on the analysis. Aircraft-launched expendable bathythermograph (AXBT) data from coincident Regional Energetics Experiment flights were used as independent ground truth. The analysis results and input data sets were compared to the AXBT data. This study shows that MCSST data significantly add to the accuracy of front and eddy mapping by tightening up strong frontal gradients and reducing the impact of relatively noisy ship data. The reliability, the accuracy, and the quantity of MCSSTs far exceed that of ship reports. This difference is evident in the better identification of significant oceanographic features by the satellite-aided analysis. Accuracy of regional EOTS analysis was found to be severely degraded when the only available MCSST data are over 48 hours old. GRA

N89-13865# Flow Research, Inc., Kent, Wash.
AN AUTONOMOUS OCEAN INSTRUMENT PLATFORM DRIVEN VERTICALLY BY THE CURRENT Final Technical Report, Sep. 1986 - May 1988
D. C. Echert, E. W. Geller, G. B. White, and J. H. Morison (Washington Univ., Seattle.) Jul. 1988 56 p
(Contracts N00014-86-C-0816; N00014-85-C-0675)
(AD-A198226; FLOW-TR-448) Avail: NTIS HC A04/MF A01 CSCL 08C

This report describes the development and initial field test results of the Autonomous Ocean Profiler (AOP). The AOP is an oceanographic instrument platform for measuring profiles of physical, thermodynamic, and biological properties in the ocean. The profiler employs a hydrodynamic lift device to fly the instrument package up and down the water column along a taut vertical cable. Because the local currents drive the platform's vertical motion, power requirements are low and, therefore, long, unattended deployments are possible. By using ARGOS and GOES satellite retrieval networks, the system can supply near real time data. The system provides profile data at very high vertical resolution in contrast to conventional buoys, which gather data only a fixed sensor depths. Because only a single set of sensors is required to cover the vertical range desired, the system is low cost and, for many applications, expendable. The initial deployment configuration is as an Arctic drifting buoy. A satellite retransmission buoy is placed on the sea ice surface with the cable suspended below the ice. Conductivity, temperature, and depth information are gathered over a depth range of 0 to 300 m. Data are internally recorded and are relayed to the surface buoy through an inductive communication link for transmission via satellite. Initial test results from Puget Sound and from an Arctic test are described. GRA

51 LIFE SCIENCES (GENERAL)

N89-13866# Wisconsin Univ., Madison.
CARBON MONOXIDE METABOLISM BY PHOTOSYNTHETIC BACTERIA Progress Report
P. W. Ludden and G. P. Roberts 1988 4 p
(Contract DE-FG02-87ER-13691)
(DE88-011569; DOE/ER-13691/T1) Avail: NTIS HC A02/MF A01

The photosynthetic bacterium, Rhodospirillum rubrum, is capable of converting carbon monoxide to CO2 and cellular material. Because carbon monoxide is a major industrial pollutant in this country and a product of the biological oxidation of CO is the product of H2, a major industrial feedstock, this process has practical importance. The oxidation of carbon monoxide to CO2 by microorganisms is a major component of the carbon monoxide cycle on earth. We have isolated the enzyme responsible for this process from Rhodospirillum rubrum. Carbon monoxide dehydrogenase is an iron - sulfur, nickel- and zinc-containing enzyme. The enzyme is quite stable to heat and amendable to purification, however, it is very labile to oxygen, and all experiments must be conducted anaerobically. We are studying the activities of this enzyme, its regulation and its induction by its substrate carbon monoxide. The enzyme is absent in cells that have not been exposed to carbon monoxide, but cells produce the enzyme at a maximal rate upon exposure to carbon monoxide for as little as ten minutes. Oxygen, a potent and irreversible inhibitor of this enzyme, represses its synthesis. DOE

N89-13867*# National Aeronautics and Space Administration, Washington, D.C.
THE 1987-1988 NASA SPACE/GRAVITATIONAL BIOLOGY ACCOMPLISHMENTS
Thora W. Halstead, ed. Nov. 1988 200 p Prepared in cooperation with George Washington Univ., Washington, D.C.
(Contract NASw-4324)
(NASA-TM-4079; NAS 1.15:4079) Avail: NTIS HC A09/MF A01 CSCL 06C

Individual technical summaries of research projects of the NASA Space/Gravitational Biology Program, for research conducted during the period January 1987 to April 1988 are presented. This Program is concerned with using the characteristics of the space environment, particularly microgravity, as a tool to advance knowledge in the biological sciences; understanding how gravity has shaped and affected life on earth; and understanding how the space environment affects both plant and animal species. The summaries for each project include a description of the research, a list of the accomplishments, an explanation of the significance of the accomplishments, and a list of publications.
Author

N89-13868# New Mexico State Univ., Las Cruces. Dept. of Biology.
VIBRIO FISCHERI SYMBIOSIS GENE REGULATION Annual Report, Aug. 1987 - Aug. 1988
Paul V. Dunlap 12 Aug. 1988 8 p
(Contract N00014-87-K-0727; RR04106)
(AD-A198846) Avail: NTIS HC A02/MF A01 CSCL 06C

The goals of our research are to investigate the molecular mechanisms controlling luminescence gene expression of the symbiotic, light-organ bacterium Vibrio fischeri; and to identify and investigate the regulation of other symbiosis functions in this marine bacterium. During the past year, we have: (1) completed studies in Escherichia coli cya and crp mutants on expression of the luxR gene that demonstrate cAMP and CRP activate transcription of luxR and that the LuxR protein, possibly working in concert with auto-inducer, represses transcription from the luxR promoter (transcription negative auto-regulation); (2) isolated mutants of V. fischeri apparently deficient in adenylate cyclase and CRP, and demonstrated the requirement for cAMP and CRP in autoinduction of luminescence and in iron regulation of luminescence; (3) initiated studies in E. coli of the role of autoinducer in luxR negative autoregulation; and, (4) initiated work toward development of a gene transfer system for V. fischeri. GRA

N89-13869# John B. Pierce Foundation of Connecticut, New Haven.
MICROWAVE IRRADIATION AND COLD EXPOSURE Final Report, 18 Jul. 1984 - 17 Jul. 1985
Eleanor R. Adair 17 Aug. 1988 12 p
(Contract N00014-84-C-0535)
(AD-A198875; JBP-ONR-3) Avail: NTIS HC A03/MF A01 CSCL 06G

A pilot study investigated the consequences of chronic exposure (40 h/wk) to 2450-MHz CW microwaves, or sham exposure, in a cold (18 C) environment on the thermoregulatory responses, both behavioral and physiological, of squirrel monkeys. Four animals exposed to microwaves at 20 mW/cm2 exhibited responses that indicated slight amelioration of the mild cold stress while four sham-exposed animals sustained no thermoregulatory deficits. Although the sample size was too small to yield statistically reliable data, general trends in the results support the view that exposure to microwaves of moderate intensity in the work environment is benign in terms of long-term effects on thermoregulatory processes. GRA

N89-14155*# North Carolina State Univ., Raleigh. Dept. of Botany.
GASEOUS EMISSIONS FROM PLANTS IN CONTROLLED ENVIRONMENTS
Denis T. DuBay *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 1-18 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 06C

N89-14167*# Connecticut Univ., Storrs. Dept. of Molecular and Cell Biology.
HORMONAL REGULATION OF WHEAT GROWTH DURING HYDROPONIC CULTURE

Donald Wetherell *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 440-454 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 06C

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N89-13870# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
27 Sep. 1988 35 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-88-016) Avail: NTIS HC A03/MF A01

Translations of various articles from Russian periodicals are translated and presented. All articles are under the general heading of Life Sciences. Some more specific areas are: Aerospace Medicine, Agricultural Science, Biochemistry, Biophysics, Genetics, Immunology, Industrial Medicine, Laser Bioeffects, Molecular Biology, Nonionizing Radiation Effects, Pharmacology and Toxicology, Physiology, and Public Health. For individual titles, see N89-13871 through N89-13871.

N89-13871# Joint Publications Research Service, Arlington, Va.
ASSESSMENT OF PAIRED ACTIVITY OF OTOLITHIC APPARATUS OF HEALTHY MEN BY STUDY ON PARALLEL SWINGS Abstract Only
E. I. Matsnev, V. K. Gavrilin, and I. Ya. Yakovleva *In its* JPRS Report: Science and Technology. USSR: Life Sciences 27 Sep. 1988 p 1 Transl. into ENGLISH from Vestnik Otorinolaringologii (Moscow, USSR), no. 2, Mar. - Apr. 1988 p 28-33 (For primary document see N89-13870 05-52)
Avail: NTIS HC A03/MF A01

Subjects (51 healthy males, ranging in age from 24 to 41 years) were positioned on a swing so that the longitudinal axis of the body coincided with the plane of rocking of parallel swings. They swung sequentially in three positions (on the back, on the right side and on the left side) and compensatory eye movements were recorded. Compensatory eye movements of the right eye and left eye were measured separately. Otolithic assymetry was recorded in 38 percent of the subjects. Physiological variance of values of assymetry of compensatory eye movements of the subjects was 7.21 + or - 0.86 degrees. The assymetry coefficient was 26.2 + or - 2.8 percent. The amplitude of compensatory eye movements of the right eye with the subject on his right side was 9.69 + or - 0.60 degrees and that of the left eye with the subject on the left side was 14.32 + or - 0.94 degrees. The amplitude of movements of the lower eye when the subject was on his side did not always exceed the amplitude of movements of the other eye. In some cases compensatory eye movements began several minutes (3 to 4) after swinging began. Author

N89-13872* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 316)
Nov. 1988 59 p
(NASA-SP-7011(316); NAS 1.21:7011(316)) Avail: NTIS HC A04; NTIS standing order as PB88-912300. $9.00 domestic. $18.00 foreign CSCL 06E

This bibliography lists 146 reports, articles, and other documents introduced into the NASA scientific and technical information system in October, 1988. Author

N89-13873# Washington Univ., St. Louis, Mo. Dept. of Neurology.
RELATING SENSITIVITY AND CRITERION EFFECTS TO THE INTERNAL MECHANISMS OF VISUAL SPATIAL ATTENTION Technical Report, 1 May 1988 - 1 May 1989
Gordon L. Shulman and Michael I. Posner 30 Apr. 1988 18 p
(Contract N00014-86-K-0289; RR04206)
(AD-A197088; TR-88-2-ONR) Avail: NTIS HC A03/MF A01 CSCL 06D

A recent paper raises the important issue of how to relate the parameters d' and beta to the internal mechanisms that process visual stimuli. This commentary considers the widely held view that d' changes reflect a variety of mechanisms leading to perception, but that beta changes reflect a single high level decision mechanism that is postperceptual and under conscious control. In a complex highly parallel, multi-level system, both sensitivity and criterion shifts may influence perception in lawful ways - neither being necessarily more basic and important. The paper, raises some methodological considerations that qualify Muller and Findlay's results. It is not argued that probability manipulations produce beta shifts in detection tasks and d' shifts in identification tasks is necessarily wrong. The implication Muller and Findlay along with others often draw from this kind of result - that detection tasks involve radically different selection mechanisms than identification tasks is questioned. In the following discussion, the terms d' and beta will refer to the quantities one computes from data collected to the theoretical variables that may underly changes in these measured quantities. GRA

N89-13874# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
IMPROVED ESTIMATION OF BODY HEAT DISTRIBUTION DURING COOLING: A FIRST ATTEMPT
B. Farnworth and G. Havenith Nov. 1987 37 p
(IZF-1987-38; TD-88-0287; ETN-88-93451) Avail: NTIS HC A03/MF A01

Cooling and rewarming experiments on supine (resting) subjects, instrumented with heat flow sensors, allowed analysis of time constants for skin temperature change. For the chest, during cooling, a short time constant of 5 min, and a long time constant of 20 min, depending of the fat layer thickness, are found. Heat resistances, depending on skin temperatures, and time constants suggest a simple core and shell system, although the data are not conclusive. For the arm, during cooling, a short time constant comparable to the chest is observed, whereas the long time constant suggests that the arm cools as a whole, like dead material. Model calculations show that the associated blood flow does not deliver a significant amount of heat, which suggests an effective counter current heat exchange. During heating, however, the blood flow is dominant. When a model is considered, consisting of head and trunk with chest characteristics, and arms and legs with arm characteristics, a significantly better but not perfect calculation of heat storage during cooling is obtained. ESA

N89-13875# Connecticut Univ., Storrs. Biomedical Engineering Lab.
HUMAN AUDITORY AND VISUAL UNIMODAL AND BIOMODAL CONTINUOUS EVOKED POTENTIALS Summary Report, Sep. 1983 - Nov. 1987
Zvi Z. Goldman Mar. 1988 88 p
(Contract F33615-81-K-0510)
(AD-A198845; AAMRL-TR-88-016) Avail: NTIS HC A05/MF A01 CSCL 06D

This research has adapted the phase-lock technique in recording of Continuous Evoked Potentials (CEPs, also referred to as steady-state potentials) for monitoring of the auditory and visual sensory channel engagement and for stimulus parameter-space characterization of the Auditory-Visual Interaction effect (AxV). Sensory interaction was concluded whenever response variations of one sensory channel could be attributed to parameter changes of an additional stimulus, simultaneously presented to another sensory channel. GRA

N89-13876# Naval Health Research Center, San Diego, Calif.
APPLIED ANTHROPOLOGY ON THE ICE: A MULTIDISCIPLINARY PERSPECTIVE ON HEALTH AND ADAPTATION IN ANTARCTICA Final Report
Lawrence A. Palinkas and E. K. Eric Gunderson 31 May 1988 21 p
(Grant NSF DPP-87-16461; DA Proj. 3M1-62770-A-870)
(AD-A198926; NHRC-88-21) Avail: NTIS HC A03/MF A01 CSCL 06J

This paper describes the health and adaptation of Antarctic winter-over personnel and outlines some of the ways in which applied medical anthropology can play a central role in understanding and improving health and performance under conditions of prolonged isolation in an extreme environment. The history of social and behavioral science research on the human experience in Antarctica is reviewed. Of particular interest are the sources and symptoms of stress among winter-over personnel, the relationship between stress and illness, and the moderating influence of personality, social support, and culture in this relationship. Scientists and support personnel who winter-over in the Antarctic experience a number of physiological and psychological changes which are a response to the harsh environmental conditions and prolonged isolation. However, the long-term record of health and performance among winter-over personnel subsequent to Antarctic duty suggest that a certain positive benefit may be acquired from the experience. This is perhaps due to the role of station microcultures which enable individuals to cope with the stress of prolonged isolation in an extreme environment. The holistic perspective of anthropology would allow for an examination of the respective contributions of group and individual processes to adaptation. GRA

N89-13877# New York Univ., New York. Dept. of Psychology.
HIGHER ORDER MECHANISMS OF COLOR VISION Annual Progress Report, 15 Sep. 1986 - 14 Mar. 1988
John Krauskopf 29 Jun. 1988 16 p
(Grant AF-AFOSR-0334-86; AF Proj. 2313)
(AD-A198093; AFOSR-88-0740TR) Avail: NTIS HC A03/MF A01 CSCL 05H

This report covers activities since September 15, 1986. The main accomplishments have been: (1) a comprehensive study of the effects of chromatic content, blur and contrast of targets on vernier acuity and on stereo acuity; (2) the use of a new method of measuring chromatic discrimination under conditions of constant adaptation; and (3) continuation of the study of the chromatic properties of single cells in the monkey cortex. GRA

N89-13878# State Univ. of New York, Albany.
THE EFFECTS OF ROTARY MOTION ON TASTE AND ODOR RATINGS: IMPLICATIONS FOR SPACE TRAVEL Final Report, 22 Jun. - 28 Aug. 1987
Ann M. Tennissen, Larry L. Lesher (Geo-Centers, Inc., Newton, Mass.), and Armand V. Cardello Dec. 1987 34 p Prepared for Battelle Columbus Labs., Ohio
(Contract JAAL03-86-D-0001)
(AD-A198241) Avail: NTIS HC A03/MF A01 CSCL 06D

Astronauts have reported that food eaten in space tastes different or bland. This experiment was designed to investigate the possible role of the motion component of space travel as a contributor to taste and/or odor preference shifts. Two subjects from the Ashton Graybiel Spatial Orientation Laboratory were used to examine the effects of motion in a rotating room on taste and odor ratings. Solutions of NaCl, sucrose, citric acid, and quinine sulfate for taste tests and 10 food odorants for odor tests were rated on both intensity and pleasantness qualities before and after time spent in a rotating room. There was an effect of this motion in one subject whose ratings differed significantly on post-rotation tests. This fact lends support to the idea that motion may be a part of the reported taste changes in space. GRA

N89-13879* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 317)
Dec. 1988 70 p
(NASA-SP-7011(317); NAS 1.21:7011(317)) Avail: NTIS HC A05 CSCL 06E

This bibliography lists 182 reports, articles and other documents introduced into the NASA scientific and technical information system in November, 1988. E.R.

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N89-13880# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
QUALITATIVE DEPTH AND SHAPE FROM STEREO, IN AGREEMENT WITH PSYCHOPHYSICAL EVIDENCE
Daphna Weinshall Dec. 1987 22 p
(Contract N00014-85-K-0124)
(AD-A197259; AD-E900802; AI-M-1007) Avail: NTIS HC A03/MF A01 CSCL 05H

This paper concentrates on the problem of obtaining depth information from binocular disparities. It is motivated by the fact that implementing registration algorithms and using the results for depth computations is hard in practice with real images due to noise and quantization errors. We will show that qualitative depth information can be obtained from stereo disparities with almost no computations, and with no prior knowledge (or computation) of camera parameters. The only constraint is that the epipolar plane of the fixation point includes the X-axes of both cameras. We derive two expressions that order all matched points in the images in two distinct depth-consistent fashions from image coordinates only. One is a tilt-related order lambda, which depends only on the polar angles of the matched points, the other is a depth-related order chi. Using lambda for tilt estimation and point separation (in depth) demonstrates some anomalies and unusual characteristics that have been observed in psychophysical experiments, most notably the induced size effect. Furthermore, the same approach can be applied to estimate some qualitative behavior of the normal to the surface of any object in the field of view. More specifically, one can follow changes in the curvature of contour on the surface of an object, with either x- or y-coordinate fixed. GRA

N89-13881# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
HUMAN PLAUSIBLE REASONING Interim Report, Sep. 1985 - Sep. 1988
Allan Collins, Mark Burstein, and Michelle Baker Jul. 1988 14 p
(Contract MDA903-85-C-0411; DA Proj. 2Q1-61102-B-74-F)
(AD-A197426; ARI-RN-88-68) Avail: NTIS HC A03/MF A01 CSCL 12E

This research note describes the current state of implementation of a cognitive computer model of human plausible reasoning, based on the theory described by Collins and Michalski. The note's goal is to use simulation as a way to test and refine the theory. This required developing appropriate memory organization and search techniques to support this style of inference, finding ways to estimate similarity in specific contexts, and to investigate ways of combining the sometimes contradictory conclusions reached when inferences of different types are used to answer questions. GRA

N89-13882# Pennsylvania Univ., Philadelphia.
DIRECT ACCESS BY SPATIAL POSITION IN VISUAL MEMORY. PART 3. THE ROLES OF UNCERTAINTY ABOUT POSITION, TARGET, AND RESPONSE IN INFORMATION RETRIEVAL Technical Report No. 4, 1 Sep. 1985 - 31 Aug. 1987

Saul Sternberg, Ronald L. Knoll, and David L. Turock 15 Aug. 1988 44 p Prepared in cooperation with AT and T Bell Labs., Murray Hill, N.J.
(Contract N00014-85-K-0643; RR04206; RR04204)
(AD-A198740) Avail: NTIS HC A03/MF A01 CSCL 05H

Storage time has dramatic effects on the retrieval of visual information specified by location. In this study we use two new experimental procedures to assess the roles in the retrieval process of uncertainty about location, target, and response, and of changes in such uncertainty with storage time. In one procedure we provided advance information of the set of alternative locations that might be queried by the probe. Insofar as spatial uncertainty plays a role in processing of the probe, this manipulation would especially benefit small arrays, and should steepen the function that relates mean reaction time to array size. In a second procedure we provided advance information of the set of alternative target stimuli and responses. Insofar as stimulus uncertainty and response uncertainty play roles in generation of the response, this manipulation would also especially benefit small arrays, and should have a similar effect on the array-size function. In sharp contrast to these expectations, we found no effect of our manipulations on the time to retrieve information from visual memory. The results add support to an explanation of the effects of storage time which attributes them to the rapid transformation of an initial random-access visual memory into a sequential-access memory. GRA

N89-13883# California Univ., Irvine. Center for the Neurobiology of Learning and Memory.
NEUROBIOLOGY OF LEARNING AND MEMORY: MODULATION AND MECHANISMS Final Report
James L. McGaugh, Norman M. Weinberger, Gary Lynch, and Richard H. Granger 1988 23 p
(Contract N00014-84-K-0391)
(AD-A198815) Avail: NTIS HC A03/MF A01 CSCL 06O

It has been known for many years that the retention of newly-acquired information can be modulated by a variety of treatments if the treatments are administered shortly after training. Such findings suggest that the processes underlying memory storage may be modulated by endogenous systems activated by training experiences. Our research has examined the possibility that hormonal systems activated by training may serve this role. Our recent work has focussed on the central mechanisms underlying the effects, on memory modulation, of treatments affecting adrenergic and opiate receptor systems. The findings of our recent research supported by this contract strongly suggest that treatments affecting adrenergic receptor systems as well as opiate receptor systems modulate memory through influence involving noradrenergic receptors in the amygdala. GRA

N89-13884# Army Research Inst. of Environmental Medicine, Natick, Mass.
COGNITIVE PERFORMANCE, MOOD STATES, AND ALTITUDE SYMPTOMATOLOGY IN 13-21 PERCENT OXYGEN ENVIRONMENTS Technical Report, Mar. - Apr. 1987
B. L. Shukitt, R. L. Burse, L. E. Banderet, D. R. Knight (Naval Submarine Medical Research Lab., Groton, Conn.), and A. Cymerman 1 Jun. 1988 45 p
(AD-A198816; USARIEM-T-18-88) Avail: NTIS HC A03/MF A01 CSCL 06J

To reduce the risk of and damage from fires, naval engineers have suggested reducing the oxygen concentration in submarines below the normal ambient level of 21 percent (PO2 = 159 torr). However, reductions to 13 percent oxygen (PO2 = 99 torr) may produce decrements in mental and physical performance, changes in mood states, or symptoms of acute mountain sickness (AMS). To investigate these possibilities, thirteen male sailors were confined and tested in a hypobaric chamber for fifteen days, where they experienced oxygen concentrations of 21, 17, 21, 13, and 21 percent for three days at each concentrations with 0.9 percent carbon dioxide and the balance nitrogen. The subjects took one 30-minute battery of cognitive tasks most mornings and a different 30-minute battery of cognitive tasks every afternoon. They also completed the Clyde Mood Scale and the Environmental Symptoms Questionnaire (ESQ) every afternoon following cognitive testing. It appears that normobaric oxygen concentrations as low as 17 percent are not likely to produce adverse effects on cognition, mood states, or AMS symptomatology. Oxygen concentrations as low as 13 percent are likely to adversely affect some performance tasks and moods, however, as well as induce AMS in about one-third of the exposed individuals. These effects are quite similar to those observed in mountain climbers at the same PO2, whose responses well may be predictive of the effects of oxygen concentrations in between 13 and 17 percent oxygen. GRA

N89-13885# Naval Health Research Center, San Diego, Calif.
A REVIEW OF PSYCHOLOGICAL STUDIES IN THE US ANTARCTIC PROGRAMME Final Report
E. K. Eric Gunderson and Lawrence A. Palinkas 28 Apr. 1988 18 p
(Grant NSF DPP-87-16461)
(AD-A198924; NHRC-88-17) Avail: NTIS HC A03/MF A01 CSCL 05H

Psychological studies were initiated at U.S. Antarctic stations during the International Geophysical Year of 1957 to 1958. Attitude and symptom questionnaires, supervisor ratings, and sociometric tests were administered to several wintering groups. A more comprehensive program of psychological studies, designed to develop selection criteria for screening Antarctic personnel, was instituted in 1962 by the U.S. Navy. A general concept of individual performance or adjustment emerged from earlier studies that included three essential components: task motivation, emotional stability, and social compatibility. Two methods, supervisor ratings and peer nominations, were used to measure these behavior components, and convergent and discriminant validities were evaluated. Regression equations were then developed to predict each behavior factor for each of three occupational groups, Navy construction personnel, Navy Administrative and technical personnel, and civilian scientists. Recent studies have focused on the impact of wintering-over stresses on long-term health and adjustment of participants. The stressors associated with prolonged isolation in a harsh environment appear to be mediated by personality, environmental, and sociocultural factors. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N89-13886*# Eagle Engineering, Inc., Houston, Tex.
CONCEPTUAL DESIGN OF A LUNAR OXYGEN PILOT PLANT LUNAR BASE SYSTEMS STUDY (LBSS) TASK 4.2
1 Jul. 1988 270 p
(Contract NAS9-17878)
(NASA-CR-172082; NAS 1.26:172082; EEI-88-182) Avail: NTIS HC A12/MF A01 CSCL 06K

The primary objective was to develop conceptual designs of two pilot plants to produce oxygen from lunar materials. A lunar pilot plant will be used to generate engineering data necessary to support an optimum design of a larger scale production plant. Lunar oxygen would be of primary value as spacecraft propellant oxidizer. In addition, lunar oxygen would be useful for servicing nonregenerative fuel cell power systems, providing requirements for life support, and to make up oxygen losses from leakage and airlock cycling. Thirteen different lunar oxygen production methods are described. Hydrogen reduction of ilmenite and extraction of solar-wind hydrogen from bulk lunar soil were selected for conceptual design studies. Trades and sensitivity analyses were performed with these models. Author

N89-13887# Navy Clothing and Textile Research Facility, Natick, Mass.
MICROCLIMATE COOLING SYSTEMS: A SHIPBOARD EVALUATION OF COMMERCIAL MODELS Final Report, Jan. - Jul. 1987
Carl R. Janik, Barbara A. Avellini, and Nancy A. Pimental Apr. 1988 44 p
(AD-A196848; NCTRF-163) Avail: NTIS HC A03/MF A01 CSCL 13A

The Navy Clothing and Textile Research Facility (NCTRF), under contract to the Navy Science Assistance Program (NSAP), evaluated the feasibility of using commercial microclimate cooling systems (MCS) in the high heat areas onboard Navy ships by conducting an evaluation aboard the USS LEXINGTON (AVT16) from 30 March to 9 April 1987. The following cooling systems were evaluated: three liquid-cooled MCS - the LSSI Cool Head, the LSSI Portapack, and the ILC Cool Vest; and two air-cooled MCS - the Encon Air System, with and without a vortex tube. Both air systems and the LSSI Portapack MCS were tethered. The remaining two MCS's were portable, battery-operated, backpack systems. A control test with no cooling system was aiso run. The evaluation consisted of having test subjects wear the MCS during their normal duty and collecting physiological, subjective, and logistical data. During the test period, environmental conditions were relatively mild: the Wet Bulb Globe Temperature (WBGT) did not rise above 34 C, and the average WBGT was 24 C. GRA

N89-13888# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A METHODOLOGY FOR PREDICTING PILOT WORKLOAD Ph.D. Thesis
Thomas F. Schuppe Aug. 1988 318 p
(AD-A197090; AFIT/CI/NR-88-169) Avail: NTIS HC A14/MF A01 CSCL 01C

This research is limited to the problem of assessing a pilot's workload while flying an aircraft. The intent is to develop and validate a mathematical model which predicts pilot workload. This effort will show the feasibility of such a model and show that the model's predictions relate reasonably well to measured workload levels. This study focuses on pilot workload in a single-seat, fighter aircraft. While the methods employed are generally applicable to other human-machine systems, it is not known if any derived conclusions can also be applied to other systems. This research is unique in that it employs a model significantly different from other existing models. This model combines predictions from discrete-event simulation with subjective predictions, while other models generally rely on a single method. In addition, this model employs the structure of an existing measurement methodology to provide a framework for these predictions. This model may be useful in early aircraft design stages to assess the impact of a particular aircraft configuration on pilot workload. GRA

N89-13889*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DON/DOFF SUPPORT STAND FOR USE WITH REAR ENTRY SPACE SUITS Patent Application
Joseph J. Kosmo, inventor (to NASA), Terry O. Tri, inventor (to NASA), William E. Spenny, inventor (to NASA), and Philip R. West, inventor (to NASA) 19 Jul. 1988 22 p
(NASA-Case-MSC-21364-1; NAS 1.71:MSC-21364-1; US-Patent-Appl-SN-221472) Avail: NTIS HC A03/MF A01 CSCL 06K

A don/doff support stand for use with rear entry space suits is disclosed. The support stand is designed for use in one-g environments; however, certain features of the stand can be used on future spacecraft, lunar, or planetary bases. The present invention has a retainer which receives a protrucing lug fixed on the torso section of the space suit. When the lug is locked in the retainer, the space suit is held in a generally upright position. In a one-g environment a portable ladder is positioned adjacent to the rear entry of the space suit supported by the stand. The astronaut climbs up the ladder and grasps a hand bar assembly positioned above the rear entry. The astronaut then slips his legs through the open rear entry and down into the abdominal portion of the suite. The astronaut then lowers himself fully into the suit. The portable ladder is then removed and the astronaut can close the rear entry door. The lug is then disengaged from the retainer and the astronaut is free to engage in training exercises in the suit. When suit use is over, the astronaut returns to the stand and inserts the lug into the retainer. A technician repositions the ladder. The astronaut opens the rear entry door, grasps the hand bar assembly and does a chin-up to extricate himself from the suit. The astronaut climbs down the movable ladder while the suit is supported by the stand. NASA

N89-13890# Institute for Defense Analyses, Alexandria, Va.
RELATING FLYING-HOUR ACTIVITY TO THE PERFORMANCE OF AIRCREWS Final Report, Jun. - Dec. 1987
Stanley A. Horowitz, Colin P. Hammon, and Paul R. Palmer Dec. 1987 34 p
(Contract MDA903-84-C-0031)
(AD-A199004; AD-E501011; IDA-P-2085; IDA/HQ-88-33010)
Avail: NTIS HC A03/MF A01 CSCL 05I

This paper assesses the feasibility of developing quantitative relationships between the capability of aviation units to perform their assigned missions and the level of resources available for aircrew training on aircrew performance. The relatively sparse literature that develops statistical links between aircrew performance and flying hours is reviewed. Quantitative evidence of the magnitude of these links is discussed, and a model for relating flying-hour activity to aircrew performance is developed. The model posits that additional flying enhances proficiency in two ways: through the short-run honing of skills and through the long-run development of mastery. Available data on aircrew performance and on training histories are described. The paper finds that statistical analysis of historical information can successfully quantify the effects of training and experience on aircrew proficiency and safety. Additional analyses of the data that exist to support such quantification are proceeding. GRA

N89-13891# South Dakota Univ., Vermillion. Human Factors Lab.
AN AUTOMATED TEST OF FITTS' LAW AND EFFECTS OF TARGET WIDTH AND CONTROL/DISPLAY GAIN USING A DIGITI ZER TABLET Interim Report, Jul. 1985 - Jan. 1986
A. K. Parng Feb. 1988 81 p
(Contract N66001-85-C-0253; S57-525)
(AD-A198202; NOSC/TD-1214) Avail: NTIS HC A05/MF A01 CSCL 12I

Motor performance in relation to response magnitude and response variability has been one of the most widely studied topics in human factors and experimental psychology. Following Shannon and Weaver's indication (1949) that information theory could be applied to psychological problems, an information-processing model combined with information theory has become a very popular approach to the study of human performance. Fitts was one of the earliest and most influential proponents of this approach. He extended information theory to the human motor system and proposed that the information capacity of the motor system can be interpreted as analogous to Shannon's Theorem 17. GRA

N89-13892# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
AN ANNOTATED BIBLIOGRAPHY OF UNITED STATES AIR FORCE ENGINEERING ANTHROPOMETRY - 1946 TO 1988
Kathleen M. Robinette and Joy Fowler May 1988 126 p
(AD-A198345; AFAMRL-TR-88-013; AFAMRL-TR-83-045) Avail: NTIS HC A07/MF A01 CSCL 05B

This report contains the titles, authors, publication/source information, and the abstracts of 223 technical reports and articles published by the Harry G. Armstrong Aerospace Medical Research Laboratory from 1946 to 1988. It is a detailed document of the scope of the effort of the Air Force in the field of engineering anthropometry to provide the information on human body size

and biomechanical characteristics of Air Force personnel required for the development and evaluation of Air Force systems, personal protective equipment, and clothing. GRA

N89-13893*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

MODEL DESCRIPTION DOCUMENT FOR A COMPUTER PROGRAM FOR THE EMULATION/SIMULATION OF A SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM (ESCM)

James L. Yanosy Sep. 1988 68 p
(Contract NAS1-17397)
(NASA-CR-181737; NAS 1.26:181737; SVHSER-9504) Avail: NTIS HC A04/MF A01 CSCL 05H

Emulation/Simulation Computer Model (ESCM) computes the transient performance of a Space Station air revitalization subsystem with carbon dioxide removal provided by a solid amine water desorbed subsystem called SAWD. This manual describes the mathematical modeling and equations used in the ESCM. For the system as a whole and for each individual component, the fundamental physical and chemical laws which govern their operations are presented. Assumptions are stated, and when necessary, data is presented to support empirically developed relationships. Author

N89-13894*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

UTILITY OF EMULATION AND SIMULATION COMPUTER MODELING OF SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS

James L. Yanosy Sep. 1988 43 p
(Contract NAS1-17397)
(NASA-CR-181739; NAS 1.26:181739; SVHSER-10640) Avail: NTIS HC A03/MF A01 CSCL 05H

Over the years, computer modeling has been used extensively in many disciplines to solve engineering problems. A set of computer program tools is proposed to assist the engineer in the various phases of the Space Station program from technology selection through flight operations. The development and application of emulation and simulation transient performance modeling tools for life support systems are examined. The results of the development and the demonstration of the utility of three computer models are presented. The first model is a detailed computer model (emulation) of a solid amine water desorbed (SAWD) CO2 removal subsystem combined with much less detailed models (simulations) of a cabin, crew, and heat exchangers. This model was used in parallel with the hardware design and test of this CO2 removal subsystem. The second model is a simulation of an air revitalization system combined with a wastewater processing system to demonstrate the capabilities to study subsystem integration. The third model is that of a Space Station total air revitalization system. The station configuration consists of a habitat module, a lab module, two crews, and four connecting nodes. Author

N89-13895*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

APPENDICES TO THE MODEL DESCRIPTION DOCUMENT FOR A COMPUTER PROGRAM FOR THE EMULATION/SIMULATION OF A SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM

James L. Yanosy Sep. 1988 106 p
(Contract NAS1-17397)
(NASA-CR-181738; NAS 1.26:181738; SVHSER-10638) Avail: NTIS HC A06/MF A01 CSCL 05H

A Model Description Document for the Emulation Simulation Computer Model was already published. The model consisted of a detailed model (emulation) of a SAWD CO2 removal subsystem which operated with much less detailed (simulation) models of a cabin, crew, and condensing and sensible heat exchangers. The purpose was to explore the utility of such an emulation simulation combination in the design, development, and test of a piece of ARS hardware, SAWD. Extensions to this original effort are presented. The first extension is an update of the model to reflect changes in the SAWD control logic which resulted from test. Also, slight changes were also made to the SAWD model to permit restarting and to improve the iteration technique. The second extension is the development of simulation models for more pieces of air and water processing equipment. Models are presented for: EDC, Molecular Sieve, Bosch, Sabatier, a new condensing heat exchanger, SPE, SFWES, Catalytic Oxidizer, and multifiltration. The third extension is to create two system simulations using these models. The first system presented consists of one air and one water processing system. The second consists of a potential air revitalization system. Author

N89-13896*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

APPENDICES TO THE USER'S MANUAL FOR A COMPUTER PROGRAM FOR THE EMULATION/SIMULATION OF A SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM

James L. Yanosy Sep. 1988 208 p
(Contract NAS1-17397)
(NASA-CR-181736; NAS 1.26:181736; SVHSER-10639) Avail: NTIS HC A10/MF A01 CSCL 05H

A user's Manual for the Emulation Simulation Computer Model was published previously. The model consisted of a detailed model (emulation) of a SAWD CO2 removal subsystem which operated with much less detailed (simulation) models of a cabin, crew, and condensing and sensible heat exchangers. The purpose was to explore the utility of such an emulation/simulation combination in the design, development, and test of a piece of ARS hardware - SAWD. Extensions to this original effort are presented. The first extension is an update of the model to reflect changes in the SAWD control logic which resulted from the test. In addition, slight changes were also made to the SAWD model to permit restarting and to improve the iteration technique. The second extension is the development of simulation models for more pieces of air and water processing equipment. Models are presented for: EDC, Molecular Sieve, Bosch, Sabatier, a new condensing heat exchanger, SPE, SFWES, Catalytic Oxidizer, and multifiltration. The third extension is to create two system simulations using these models. The first system presented consists of one air and one water processing system, the second a potential Space Station air revitalization system. Author

N89-13897*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

USER'S MANUAL FOR A COMPUTER PROGRAM FOR THE EMULATION/SIMULATION OF A SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM (ESCM)

James L. Yanosy Sep. 1988 216 p
(Contract NAS1-17397)
(NASA-CR-181735; NAS 1.26:181735; SVHSER-9503) Avail: NTIS HC A10/MF A01 CSCL 05H

This manual describes how to use the Emulation Simulation Computer Model (ESCM). Based on G189A, ESCM computes the transient performance of a Space Station atmospheric revitalization subsystem (ARS) with CO2 removal provided by a solid amine water desorbed subsystem called SAWD. Many performance parameters are computed some of which are cabin CO2 partial pressure, relative humidity, temperature, O2 partial pressure, and dew point. The program allows the user to simulate various possible combinations of man loading, metabolic profiles, cabin volumes and certain hypothesized failures that could occur. Author

N89-13898*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

REPORT OF THE 1ST PLANNING WORKSHOP FOR CELSS FLIGHT EXPERIMENTATION

John W. Tremor and Robert D. MacElroy 1988 28 p Workshop held at Moffett Field, Calif., 23-24 Mar. 1987
(NASA-CP-10020; A-88265; NAS 1.55:10020) Avail: NTIS HC A03/MF A01 CSCL 05H

A workshop held March 23 and 24, 1987 to establish a base upon which a CELSS flight experiment program will be developed, is summarized. The kind of information necessary for productivity assessment was determined. In addition, generic experiments necessary to gather that information were identified and prioritized. General problems of hardware and equipment were defined. The need for the hardware to provide a stress-free environment, not only for productivity, but also to make more readily identifiable disturbing mission factors, was recognized. Author

N89-13899*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Displays and Controls Lab.
HUMAN FACTORS STUDIES OF CONTROL CONFIGURATIONS FOR ADVANCED TRANSPORT AIRCRAFT
Harry L. Snyder, Robert W. Monty, and Joe Old (Research Triangle Inst., Hampton, Va.) 31 Aug. 1985 29 p
(Grant NAG1-491)
(NASA-CR-184608; NAS 1.26:184608) Avail: NTIS HC A03/MF A01 CSCL 05H

This research investigated the threshold levels of display luminance contrast which were required to interpret static, achromatic, integrated displays of primary flight information. A four-factor within-subjects design was used to investigate the influences of type of flight variable information, the level of ambient illumination, the type of control input, and the size of the display symbology on the setting of these interpretability thresholds. A three-alternative forced choice paradigm was used in conjunction with the method of adjustments to obtain a measure of the upper limen of display luminance contrast needed to interpret a complex display of primary flight information. The pattern of results and the absolute magnitudes of the luminance contrast settings were found to be in good agreement with previously reported data from psychophysical investigations of display luminance contrast requirements. Author

N89-14164*# Florida Inst. of Tech., Melbourne. Dept. of Computer Science.
THE DESIGN OF AN INTELLIGENT HUMAN-COMPUTER INTERFACE FOR THE TEST, CONTROL AND MONITOR SYSTEM
William D. Shoaff *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 311-383 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N89-13900*# George Washington Univ., Washington, D.C.
PUBLICATIONS OF THE BIOSPHERIC RESEARCH PROGRAM: 1981-1987 Contractor Report, 1981-1987
Janice S. Wallace, ed. Washington NASA Dec. 1988 48 p
(Contract NASw-4324)
(NASA-CR-4204; NAS 1.26:4204) Avail: NTIS HC A03/MF A01 CSCL 06B

Presented is a list of publications of investigators supported by the Biospheric Research Program of the Biological Systems Research Branch, Life Sciences Division, and the Office of Space Science and Applications. It includes publications dated as of December 31, 1987 and entered into the Life Sciences Bibliographic Database at the George Washington University. Publications are organized by the year published. Author

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N89-13901# Colorado State Univ., Fort Collins.
COMPUTER SCIENCE AND STATISTICS. PROCEEDINGS OF THE 18TH SYMPOSIUM ON THE INTERFACE Final Report, 15 Feb. 1986 - 14 Feb. 1987
Thomas J. Boardman, ed. and Irene M. Stefanski, ed. (American Statistical Association, Washington, D. C.) 26 Aug. 1987 451 p Symposium held in Fort Collins, Colo., 19-21 Mar. 1986
(Grant AF-AFOSR-0070-86; AF Proj. 2304)
(AD-A191296; AFOSR-88-0153TR) Avail: NTIS HC A20/MF A01 CSCL 12F

The procedings of a conference on the interface between computer science and statistics are given. Parallel algorithms, parallel architecture, decision making, computer graphics, programming languages, data management, data base management systems, expert systems, survey sampling, supercomputer techniques, and simulation are among the topics discussed. For individual titles, see N89-13902 through N89-13962.

N89-13902# Maryland Univ., College Park. Dept. of Computer Science.
COMMUNICATION IN PARALLEL ALGORITHMS: AN EXAMPLE **c61**
G. W. Stewart *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 11-14 (For primary document see N89-13901 05-60)
(Grant AF-AFOSR-0078-82)
Avail: NTIS HC A20/MF A01 CSCL 12F

The purpose of this note is to describe and analyze a parallel algorithm for computing the QR factorization of an n x p matrix X. The algorithm is designed to run on a ring of r processors that communicate by message passing. The sequential algorithm and its numerical properties, the parallel version of the algorithm, and its analysis are described. Analysis suggests some modifications of the algorithm, which are discussed. Author

N89-13903# Cornell Univ., Ithaca, N.Y.
MATRIX COMPUTATIONS, SIGNAL PROCESSING AND SYSTOLIC ARRAYS **c61**
Franklin T. Luk *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 15-19 (For primary document see N89-13901 05-60)
(Contract N00014-85-K-0074)
Avail: NTIS HC A20/MF A01 CSCL 12F

Parallel matrix computing has become an essential part of real-time signal processing. Systolic arrays and associated algorithms for computing the symmetric eigenvalue decomposition, the singular value decomposition and the generalized singular value decomposition are described in detail. Author

N89-13904# Carnegie-Mellon Univ., Pittsburgh, Pa.
PARALLEL ARCHITECTURE: A TUTORIAL FOR STATISTICIANS **c62**
William F. Eddy *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 23-29 (For primary document see N89-13901 05-60)
(Contracts N00014-84-G-0137; N00014-84-K-0588; NSF MCS-82-05126; NSF DMS-84-04927)
Avail: NTIS HC A20/MF A01 CSCL 12F

The purpose of this article is to provide a brief introduction to the various notions of parallelism and their realization in various hardware architectures. An introduction to the terminology and programming notions needed in concurrent programming is given as well as a short review of the particular classes of parallel architecture that were found to be useful. The sections on concurrent programming introduce the two key notions that are necessary for an understanding of the parallel execution of programs: interprocess communications and process synchronization. Author

N89-13905# Carnegie-Mellon Univ., Pittsburgh, Pa.
DISCRETE-FINITE INFERENCE ON A NETWORK OF VAXes **c62**
William F. Eddy and Mark J. Schervish *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 30-36 (For primary document see N89-13901 05-60)
(Contracts N00014-84-G-0137; N00014-84-K-0588; NSF MCS-82-05126; NSF DMS-84-04927)
Avail: NTIS HC A20/MF A01 CSCL 12F

Because all data are discrete and because all digital computation is discrete, the consequences of abandoning the implied approximations involved in the use of continuous-parameter models for continuous random variables were investigated. In particular, models for discrete random variables specified by probabilities which can only assume a finite number of values were studied. If we allow all possible models, the amount of calculation required is really formidable; for one very simple example it is estimated that one million years of cpu time are required to determine the predictive distribution for a single future observation. Consequently, effort is needed both to reduce the amount of calculation required and to speed up the calculation that must be done. Of particular interest in this regard is the use of multiple microcomputers as parallel processors. This breakthrough has two important advantages. Firstly, it dramatically reduces the wall clock time required to perform the discrete-finite calculations. Secondly, it provides a numerically more stable algorithm for computing the results. Author

N89-13906# Texas Univ., Austin.
MacSpin: GRAPHICAL DATA ANALYSIS **c61**
Andrew W. Donoho, David L. Donoho, and Miriam Gasko (Chicago Univ., Ill.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 59-62 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

MacSpin has advanced graphics capabilities. It goes beyond two-dimensional x-y plots, and lets you view and interact with data in 3 dimensions - and more. You can view x-y-z plots, rotating them in real time to get a true three-dimensional perception of the structure of your data. By means of animation, you can make movies of your data showing how the three-dimensional cloud varies as a function of a fourth variable. MacSpin is a useful tool for identifying trends, patterns, clusters and outliers in high-dimensional data. The capability for augmenting the display with text information allows one to identify datapoints (e.g., outliers) and correlate qualitative information with the patterns you observe in the display. MacSpin offers easy modes for inputting data and for porting data from other programs and mainframes. It also has useful documentation capabilities that allow one to produce hard copy of screen views, or to insert such images into other computer documents. And all these operations can be carried out by MacSpin with the user simply pointing and clicking with the mouse. Here, the main features of the program are illustrated by telling the story of its application to two datasets. Author

N89-13907# Bell Telephone Labs., Inc., Murray Hill, N. J.
GRAP: A LANGUAGE FOR STATISTICAL DISPLAYS **c61**
Jon L. Bentley and Brian W. Kernighan *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 63-68 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Unix tools for preparing publication-quality graphical displays are described. A general-purpose graphing language, GRAP, provides for automatic scaling and tick marks, input data transformation and processing, multiple independent coordinate systems, and multiple graphs in a single display. Specialized languages (implemented as GRAP preprocessors) deal with specialized graphs, such as dotcharts, box plots and scatter-plot matrices. Although originally designed for document preparation, GRAP has been used for such diverse tasks as exploratory data analysis and prototyping new graphical displays. Author

N89-13908*# Texas Univ., Austin.
BINARY IMAGE CLASSIFICATION
Carl N. Morris *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 71-74 Sponsored by NASA, Washington, D.C. (For primary document see N89-13901 05-60)
(Grant NSF DMS-84-07876)
Avail: NTIS HC A20/MF A01 CSCL 09B

Motivated by the LANDSAT problem of estimating the probability of crop or geological types based on multi-channel satellite imagery data, Morris and Kostal (1983), Hill, Hinkley, Kostal, and Morris (1984), and Morris, Hinkley, and Johnston (1985) developed an empirical Bayes approach to this problem. Here, researchers return to those developments, making certain improvements and extensions, but restricting attention to the binary case of only two attributes. Author

N89-13909*# Wisconsin Univ., Madison.
PARTIAL AND INTERACTION SPLINE MODELS FOR THE SEMIPARAMETRIC ESTIMATION OF FUNCTIONS OF SEVERAL VARIABLES
Grace Wahba *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 75-80 (For primary document see N89-13901 05-60)
(Grants NAG5-316; NSF DMS-84-04970)
Avail: NTIS HC A20/MF A01 CSCL 09B

A partial spline model is a model for a response as a function of several variables, which is the sum of a smooth function of several variables and a parametric function of the same plus possibly some other variables. Partial spline models in one and several variables, with direct and indirect data, with Gaussian errors and as an extension of GLIM to partially penalized GLIM models are described. Application to the modeling of change of regime in several variables is described. Interaction splines are introduced and described and their potential use for modeling non-linear interactions between variables by semiparametric methods is noted. Reference is made to recent work in efficient computational methods. Author

N89-13910# Language of Data Project, Sausalito, Calif.
TABLES AND GRAPHS AS LANGUAGE **c61**
Nancy Clark, ed. *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 83-89 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The theoretical framework of the Language of Data is discussed in Dolby, Clark, and Rogers (1986). Here, the language half of the theory is discussed in further detail. Although we are not

accustomed to thinking of visual displays as having formal language properties, tables and graphs follow all the rules of written language, from the larger organizational structure of text down to the sentence grammar of ordinary English. In tables these properties are reflected directly in the tabular form. To identify their counterparts in graphs it is necessary to look more closely at the common structure of visual and verbal language. Author

N89-13911# RAND Corp., Santa Monica, Calif.
IMPLICATIONS OF THE LANGUAGE OF DATA FOR COMPUTING SYSTEMS **c61**
William H. Rogers *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 90-95 Prepared in cooperation with Language of Data Project, Sausalito, Calif. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The kind of computer system envisioned under the Language of Data (LOD), including applications which have been implemented and elements not yet developed, is discussed. As such, the system represents a design consideration for future software developers rather than a finished product. Moreover, the set of programs discussed here should not be confused with the theory itself. The understanding of the structure of the datum and of tables developed by this project could be applied to other programs as well. The envisioned programs focus primarily on three themes. First, they focus on a principal application of LOD, the documentation of large databases. Second, they illustrate some of the formal ideas (computation with descriptors and applicability conditions) in ways familiar to statisticians. Third, they incorporate some of the insight into table structure to provide several natural and powerful tools for the data analyst. Author

N89-13912# San Jose State Univ., Calif.
THE LANGUAGE OF DATA: A GENERAL THEORY OF DATA **c61**
James L. Dolby, Nancy Clark, ed., and William H. Rogers (RAND Corp., Santa Monica, Calif.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 96-103 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The general theory represented by the Language of Data has a number of implications for the communication of information, a documentation system for databases, storage and retrieval systems, computational aids for analysis, and the construction of survey instruments. More important, it provides a general framework for a systematic approach to the communication of information through data. Author

N89-13913# San Jose State Univ., Calif.
INTELLIGENT DATA MANAGEMENT **c61**
Henson Graves and Ruth Manor *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 104-109 Prepared in cooperation with Tel-Aviv Univ., Israel (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Intelligent computer support for statistical data analysis requires a system in which descriptive information is represented and used deductively to answer questions from data, definitions and assumptions. The knowledge representation requirements for supporting data analysis include flexibility in interactively introducing changes in the system and the capability of handling data revision and data discrepancy. Outlined here are a formalism for representing descriptive information and auxillary assumptions for data analysis. This formalism is currently being developed and implemented in the Algos computational system. Author

N89-13914# Imperial Coll. of Science and Technology, London (England).
A FRONT-END FOR GLIM **c61**
J. A. Nelder and D. Wolstenholme *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 113-117 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Like most current statistical packages, GLIM assumes that the user knows how to do an analysis, and provides him with easily-used tools for doing it. Described here is a knowledge-based front end (KBFE) for GLIM, currently under construction, which embodies statistical expertise to aid the user in the choice of models for his analysis. The front-end will not be a black box, delivering the correct analysis to the user, and requiring from him little more than a description of his data. Our aims for the KBFE are three-fold: (1) to give good advice to the user on the analysis, (2) to do so in a way that encourages the user to do better next time and, (3) to satisfy the requirements of a range of user skills. The front-end will be one with fixed rules, i.e., it will not be intelligent in the sense of Student (Gale, 1985), which learns from its experience of users and modifies its rules accordingly. It will be an expert system in the sense that it contains rules which encapsulate expertise. Author

N89-13915# Harvard Univ., Cambridge, Mass.
ARTIFICIAL INTELLIGENCE TECHNIQUES FOR RETROSPECTIVE HELP IN DATA ANALYSIS **c63**
William H. Nugent *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 118-121 Sponsored in part by ONR, Washington, D.C. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A tool is presented which has been developed to address the meta problem of script analysis - the determining of the definitions and interdependencies of commands and variables. This is a natural area to automate for three reasons: (1) searching through a script to find a variable or command reference is a tedious process; (2) an analyst makes mistakes when searching manually through the script; and (3) researchers have proven A.I. technology which can be applied to this problem. Author

N89-13916# Iowa State Univ. of Science and Technology, Ames.
P.C. CARP: VARIANCE ESTIMATION FOR COMPLEX SURVEYS **c65**
Dan Schnell, Gary Sullivan, William J. Kennedy, and Wayne A. Fuller *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 125-129 Sponsored in part by Census Bureau, Washington, D.C. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Taylor approximations for the variances of the approximate distributions of statistics computed from complex surveys are outlined. A program implementing variance estimation on the IBM-PC for use with large scale surveys is described. The program will compute estimators and estimated variances for totals, ratio subpopulation means and regression coefficients. Author

N89-13917# California Univ., Los Angeles.
INFERENCE FROM COARSE DATA USING MULTIPLE IMPUTATION **c61**
Daniel F. Heitjan and Donald B. Rubin (Harvard Univ., Cambridge, Mass.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 138-143 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The procedure of producing multiple imputations under a variety of models generated the following conclusions: (1) the square-root scale model with medium, variable intervals was preferred on the basis of diagnostic displays; (2) the variable intervals models led to less information loss; and (3) the point estimate of fraction malnourished was relatively insensitive to reasonable model specifications when considered as a fraction of its standard error. For further research purposes, a multiply imputed data set is

available with five repeated draws of true ages from the preferred model (I = variable, S = square root, W = medium, R = rounded). From Table 2, the information loss for pi with this model is approximately 8.6 percent, which means that estimates based on the five imputed values have 1.7 percent more variance than those based on an infinite number of imputed values, and the number of degrees of freedom in reference distributions is unaffected by the finiteness of the number of imputations. Author

N89-13918# Pacific Northwest Labs., Richland, Wash.
EXPERIENCES WITH A DATA ANALYSIS MANAGEMENT PROTOTYPE **c82**
Paula J. Cowley, Daniel B. Carr, and Wesley L. Nicholson *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 147-150 Previously announced as N87-11626 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 05B

An evaluation of a prototype data analysis management system is presented. This system was designed to aid the analyst in keeping track of the course of a data analysis. Evaluated features include capabilities to graphically depict the course of the analysis, to return to previous milestones in the analysis, the ability to use segments of the log that describe the course of the analysis, and the ability to associate both written and spoken documentation with milestones of the analysis. Author

N89-13919# Chicago Univ., Ill.
TOOLS FOR DATA ANALYSIS MANAGEMENT **c61**
Ronald A. Thisted *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 152-159 (For primary document see N89-13901 05-60)
(Grant NSF DMS-84-12233)
Avail: NTIS HC A20/MF A01 CSCL 12F

Interactive statistical computer programs represent one class of tools which have made it easier for statisticians to carry out the computations associated with data analysis. Additional tools, both software and hardware, which can be combined with interactive statistical packages to make it easier for the statistician to implement a personal strategy for analyzing data are discussed. An integrated collection of tools for data analysis is called a computing environment. The DAMSL computing environment which is built around off-the-shelf hardware and software costing less than $4,000 is described. This environment is designed to alleviate many of the managerial burdens which arise in analyzing data. Author

N89-13920# Massachusetts Inst. of Tech., Cambridge.
STATISTICALLY SOPHISTICATED SOFTWARE AND DINDE **c61**
R. W. Oldford and S. C. Peters *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 160-167 (For primary document see N89-13901 05-60)
(Grant NSF IST-84-20614)
Avail: NTIS HC A20/MF A01 CSCL 12F

A prototype system called DINDE and the directed network model of statistical analysis on which it is currently based are discussed. DINDE is a highly interactive display oriented system where the user carries out the analysis by building and maintaining a network representation of it. An example analysis is used to describe this interaction and the analysis management tools required. Author

N89-13921# Washington Univ., Seattle.
A DATA VIEWER FOR MULTIVARIATE DATA
Andreas Buja, Catherine Hurley, and John Alan McDonald *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 171-174 Prepared in cooperation with Bell Communications Research, Inc., Holmdel, N.J. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The Data Viewer is a system for the exploratory analysis of large, high-dimensional datasets, being developed on a Lisp Machine. Suppose we have a multivariate dataset consisting of up to 1000 observations on an (arbitrarily large) number of quantitative variables. How can we examine it. The data viewer tackles this problem using Grand Tour techniques: by moving projection planes it displays a scatterplot movie. Design issues are crucial in the development of this system, in particular with regard to questions of user interface. The Lisp Machine supports object-oriented programming and the use of constraints, and these features are influential in our implementation. Author

N89-13922# Rochester Univ., N. Y.
INTERACTIVE COLOR GRAPHIC DISPLAY OF DATA BY 3-D BIPLOTS **c61**
K. Ruben Gabriel, Anup Basu, Charles L. Odoroff, and Terry M. Therneau *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 175-178 (For primary document see N89-13901 05-60)
(Contract N00014-80-C-0837)
Avail: NTIS HC A20/MF A01 CSCL 12F

The researchers' experience in displaying data as 3-D biplots by means of two alternative graphics devices: (1) the standard high resolution graphics terminals with attendant printer plots or pen plotters, and (2) the Raster Technologies Model ONE/20 frame buffer color device with attendant black-and-white laser printer, is discussed. Biplots are particularly effective for exploring multivariate data matrices or subsets of them. Author

N89-13923# Oak Ridge National Lab., Tenn.
ALGORITHMS FOR BAYESIAN VARIABLE SELECTION IN REGRESSION **c61**
Toby J. Mitchell and John J. Beauchamp *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 181-182 Previously announced as N86-33094 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A Bayesian approach to the problem of deciding which subset of a proposed set of k predictor variables to include in a linear regression model that is to be used for prediction was developed. The direct implementation of this method requires the computation of the usual regression statistics for each of the 2 sup k possible submodels. Researchers present here a branch-and-bound method which yields the same results much more quickly by eliminating from consideration those submodels which are destined to have negligible posterior probability. Implementation of the algorithm on the Cray X-MP supercomputer is discussed. Author

N89-13924# Colorado State Univ., Fort Collins.
SIMULATION OF RADAR AND SURFACE MEASUREMENTS OF RAINFALL **c47**
V. Chandrasekar and V. N. Bringi *In its* Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 183-19 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 04B

Researchers considered a class of statistical simulations which are computationally intensive and amenable to implementation on a vector computer. Two totally different types of measurements, viz., radar, and surface disdrometer, measurements of rainfall were simulated. These simulations involve exponential, Poisson and gamma random deviates. The problem is a large scale one since the parameters describing the rainfall must be varied over a wide range. Thus, complete control over the physical and statistical variables was obtained. Simulations were applied to explain why the correlation is less in plots of radar measured reflectivity verses surface measured rain intensity as compared to plots when both quantities are obtained from surface instruments. Previous interpretations have ascribed this feature to physical causes. While

physical factors are important when comparing radar measurements of rainfall to surface measurements of rain intensity, it is important to have a good measure of statistical variabilities before ascribing the features to physical causes alone. Author

N89-13925# Kentucky Univ., Lexington.
A STATISTICAL LANGUAGE FOR MICROCOMPUTERS **c61**
David M. Allen *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 233-235 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A programming language is a systematic notation which one uses to instruct the computer to do a task. A statistical language is a programming language which makes it easier to instruct a computer to do a statistical analysis. It would have predefined data types, default values for certain variables, and understood objects in certain expressions. It would have built-in procedures for application of the most frequently used statistical software. A summary of desired features in a statistical language is given. Implementation of the features would represent a considerable advancement from existing statistical software. Author

N89-13926# Illinois State Univ., Normal.
MATRIX LANGUAGES FOR STATISTICS **c61**
Kenneth N. Berk *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 236-243 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Seven matrix languages - APL combined with STATGRAPHICS, GAUSS, SAS IML and MATRIX, MATLAB, S, and SPEAKEASY, which are listed along with the vendor addresses, are discussed. Tables 1 through 12 indicate the presence of various features in these languages. A summary of features of each language is given along with a discussion of some desirable features for future implementation. Author

N89-13927# Ottawa Univ. (Ontario).
PUBLISHING STATISTICAL SOFTWARE **c61**
John C. Nash *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 244-247 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Statistical computation is at the heart of a large part of all statistical research and analysis. The growing complexity and diversity of software for statistical computations implies that statisticians spend a growing proportion of their professional lives developing, learning, and using such software. The mechanisms by which statistical software is published, that is, made available to statistical practitioners are discussed. In particular, emphasis is placed on the issue of academic or commercial credit for the research and development work which good software demands. Potential approaches to inclusion of software are discussed. Author

N89-13928# AT and T Information Systems Labs., Denver, Colo.
ESTIMATION OF RESPONSE TIME CHARACTERISTICS IN PRIORITY QUEUEING NETWORKS VIA AN INTERPOLATION METHODOLOGY BASED ON SIMULATION AND HEAVY TRAFFIC LIMITS **c61**
B. Simon and J. S. Willie *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 251-256 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Consider a network of priority queues, and suppose one is interested in describing some characteristics, say f (lambda), of a particular response time distribution as a function of the arrival rate lambda. Here, f (lambda) might be a moment or quantile of the response time distribution, or any of a number of other interesting functions of the arrival rate. A technique for estimating f (lambda) as a function of lambda over some region of interest is presented. The technique involves estimation of the f (lambda) at a few values of lambda by discrete event simulation, normalization of the estimated f (lambda), regression of a low order polynomial on the normalized estimated f (lambda), and the heavy traffic value, and, finally, a renormalization of the fitted polynomial. Author

N89-13929# Bell Telephone Labs., Inc., Murray Hill, N. J.
ON SOME STATISTICAL ISSUES IN SIMULATION STUDIES **c61**
C. L. Mallows and V. N. Nair *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 261-264 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Researchers point out some statistical techniques that have not been fully exploited in simulation studies, and show how they work in two very simple examples. The techniques discussed are data-analysis, experimental design, and smoothing. Many workers in statistics have begun to move away from the use of rigid models for data towards more flexible, data-determined models. This goes along with a more algorithmic view of the process of data analysis. Often, in a simulation study, the purpose is to obtain qualitative understanding, and not (at least originally), precise estimates of model parameters. Thus these modern attitudes become relevant. Author

N89-13930# Toronto Univ. (Ontario).
BOOTSTRAP CONFIDENCE INTERVALS **c61**
Robert Tibshirani *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 267-273 Sponsored in part by the Natural Sciences and Engineering Research Council of Canada (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The various techniques that have been proposed for constructing non-parametric confidence intervals using the bootstrap are described. These include bootstrap pivotal intervals, percentile and bias-corrected percentile intervals, and non-parametric profile likelihood intervals. These methods are small sample improvements over the usual theta plus or minus (c) sigma intervals. They are discussed in detail, and the underlying assumptions in each case are outlined. Finally, the various intervals are compared in a small simulation study. Author

N89-13931# Bell Telephone Labs., Inc., Murray Hill, N. J.
MAXIMUM LIKELIHOOD AND QUASI-LIKELIHOOD FOR NONLINEAR EXPONENTIAL FAMILY MODELS **c61**
David M. Gay and Roy E. Welsch (Massachusetts Inst. of Tech., Cambridge.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 277-284 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Linear and nonlinear exponential family and quasi-likelihood regression models form a class of models exhibiting a common structure that invites using one algorithmic framework to compute parameter estimates and regression diagnostics for all members in the class. This framework extends work on nonlinear least squares; it includes iteratively reweighted least squares, but also encompasses secant updates for a piece of the Hessian matrix of the likelihood or quasi-likelihood function along with adaptive decisions about when to use this information. The framework also provides much of the machinery needed to compute leave one out-style regression diagnostics. The framework, some implementation details, and some numerical experience are presented. Author

N89-13932# National Bureau of Standards, Washington, D.C.
AN EFFICIENT ALGORITHM FOR ORTHOGONAL DISTANCE DATA FITTING **c61**

Paul T. Boggs, Richard H. Byrd, and Robert B. Schnabel (Colorado Univ., Boulder.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 285-293 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

One of the most widely used methodologies in scientific and engineering research is the fitting of equations to data by least squares. In cases where significant observation errors exist in all data, the ordinary least squares approach is often inappropriate. An alternate approach, suggested by several researchers, involves minimizing the sum of squared orthogonal distances between each data point and the curve described by the model equation. Researchers refer to this as orthogonal distance regression (ODR). Described here is a method for solving the orthogonal distance regression problem that is a direct analog of the trust region Levenberg-Marquardt algorithm. The number of unknowns involved is the number of model parameters plus the number of data points, often a very large number. By exploiting sparsity, however, the algorithm has a computational effort per step which is of the same order as required for the Levenberg-Marquardt method for ordinary least squares. The theoretical properties of the algorithm are summarized, and results of computational tests that illustrate some differences between the two approaches are given. Author

N89-13933# Minnesota Univ., Duluth.

THE APPLICATION OF CONVEX HULLS IN MULTIPLE DIMENSIONS **c61**

Max Benson, Kinley Larntz, Michael Lavine (Minnesota Univ., Saint Paul.), and Ronald Regal *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 297-301 Sponsored in part by EPA, Washington, D.C. (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

Convex hulls and minimum covering ellipsoids are two possible methods for defining the region of space enclosed by given points. Algorithms for computing these regions in multidimensional space were implemented and investigated. The minimum covering ellipsoid implementation takes much less time and storage than the convex hull. The expected probability content for the convex hulls in higher dimensions is small. Author

N89-13934# International Mathematical and Statistical Library, Houston, Tex.

A JOHNSON CURVE APPROACH TO WARMING UP TIME SERIES SIMULATIONS **c61**

David A. Burn *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 302-306 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

The simulation of a time series from a specified autoregressive moving average (ARMA) model requires knowledge of the initial values of the time series and/or innovations process. Given independent, identically distributed zero mean innovations, the start values of the time series are often derived from a moving average approximation of the series. This approximation introduces bias of a transient nature into the system, and requires the simulation to be run for a period of time in order to diminish the influence of the initial values of the series. To avoid the necessity of warming up the simulation, researchers consider a Johnson curve approximation of the distribution of the initial values of the time series. Author

N89-13935# International Mathematical and Statistical Library, Houston, Tex.

CENSORED DISCRETE DATA AND GENERALIZED LINEAR MODELS **c61**

Douglas B. Clarkson *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 307-311 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

Generalized linear models in discrete data encompass, among other models, logistic regression models, probit models, and Poisson regression models. An algorithm for computing parameter estimates in such models when interval (and other) censoring is present in the data is discussed. Also discussed are some solutions to problems encountered in the algorithm along with the statistical implications of some forms of model degeneracy. Finally, censored data analogues of some common non-censored data graphical techniques and statistics are given. Author

N89-13936# RCA Labs., Princeton, N. J.

HOTELLING'S T2, ROBUST PRINCIPAL COMPONENTS AND GRAPHICS FOR SPC **c61**

David Coleman *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 312-326 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

Correlated variables in the same physical unit are commonly measured for purposes of statistical process control (SPC) - for example, dimensions of a manufactured part. The multivariate control chart using Hotelling's T sup 2 statistic is an effective process control technique for this multivariate situation. A common problem, however, has been how to make practical use of such control charts. It is often hard to interpret out-of-control declarations so as to produce control actions which correct the problem. Robust principal components analysis captures the covariance structure of subgroups of multivariate observations. Corresponding graphical techniques help us interpret bias and variability problems much more effectively than can a multivariate control chart alone. These methods can be used to develop a diagnostic SPC system. Author

N89-13937# Arizona State Univ., Tempe.

COLLINEARITY AND POINTS OF EXPANSION IN POLYNOMIAL REGRESSION Interim Report **c61**

Michael F. Driscoll *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 327-331 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

Frequent use is made of single- and multivariable polynomial regression models in situations for which prior knowledge fails to suggest a specific response function. In such models, the numerical and statistical stability of the least-squares estimators are highly dependent on the point of expansion, or origin, used for the underlying predictor variables. Results of some mathematical analyzes of this phenomenon are given. Related issues in variable selection and diagnostic checking are also considered. Author

N89-13938# Carnegie-Mellon Univ., Pittsburgh, Pa.

A WORKSTATION-BASED ENVIRONMENT FOR STATISTICAL ANALYSIS OF SET-VALUED DATA **c61**

Lionel Galway *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 332-334 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 12F

Although set-valued data exists in many fields, statistical techniques for analyzing such data are not well-developed. One problem with set-valued data is that almost any non-trivial analysis makes heavy computational demands and requires computer graphics; such usage of central mainframe computers can be quite expensive. The current state of development of an integrated software package to analyze two-dimensional set-valued data is discussed. Included are routines for manipulating and doing calculations on sets, facilities for generating pseudo-random sets, and provisions for graphical output and user interaction. Although much of the package has been designed to be system-independent, it takes full advantage of the unique facilities of the ANDREW

window manager and the VICE distributed file system, plus the availability at Carnegie-Mellon University (CMU) of powerful workstations with graphical input devices and high-resolution bit-mapped graphics displays (ANDREW and VICE were developed by the Information Technology Center at CMU to support a campus-wide network of personal workstations). Author

N89-13939# Bell Telephone Labs., Inc., Holmdel, N. J.
UPPER AND LOWER PROBABILITY: A GENERAL FRAMEWORK FOR MODELING UNCERTAINTY **c65**
Yves L. Grize *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 339-343 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

The theory of upper and lower probability, also called interval-valued probability, is reviewed. Interest in this theory has recently been stimulated by the attempts to apply the theory of belief functions to artificial intelligence, especially expert systems designs. Upper and lower probabilities provide an attractive general framework for modeling uncertainty because of their large scope of interpretations. They include not only conventional probabilities, belief functions and envelopes of measures but also new uncertainty functions that cannot be related to conventional probabilities. The problem of the numerical complexity of the theory is discussed. A family of lower probabilities that are easy to use and should be large enough for most practical applications is described. Some limitations of the theory will also be discussed. Author

N89-13940# Colorado State Univ., Fort Collins.
THE NUMERICAL SOLUTION OF A SYSTEM OF ORDINARY STOCHASTIC DIFFERENTIAL EQUATIONS ON THE CYBER 205 SUPERCOMPUTER **c65**
Tim Haas *In its* Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 344-34 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

A numerical method using an Ornstein-Uhlenbeck approximation to the Wiener Process coupled to a Runge-Kutta algorithm has been programmed on the Cyber 205 supercomputer to solve systems of ordinary stochastic differential equations (OSDE'S). Each equation may be any programmable function of the independent and dependent variables optionally multiplied by a stochastic process and/or with an additive stochastic process. Equations with analytical solutions are solved and errors presented. Cyber 205 timings are presented along with remarks concerning the vectorization of the code. Author

N89-13941# Massachusetts Inst. of Tech., Cambridge.
SOLVING NONLINEAR ECONOMETRIC MODELS USING VECTOR PROCESSORS **c61**
Patrick J. Henaff and Alfred L. Norman (Texas Univ., Austin.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 348-351 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The design and implementation of a reduced Newton algorithm for solving large non-linear econometric models on a vector processor such as the CYBER 205 or a CRAY X/MP machine are discussed. To take full advantage of the vector processing capabilities, one needs to organize the computations since that operations are carried on vectors. For the price of a small start-up time, which varies with machines, a vector processor performs a floating point operation on a component of a vector in a fraction of the time needed to perform the same operation on an isolated scalar. Author

N89-13942# Toronto Univ. (Ontario).
B-SPLINE ESTIMATION OF THE HAZARD FUNCTION IN PERIOD ANALYSIS **c64**
John J. Hsieh *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 352-358 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

A precise method for estimating the hazard function, survival fuction and density function for period analysis using B-splines is discussed. Explicit expressions for the representation of the hazard function as a linear combination of quadratic B-splines are obtained. Accuracy is achieved by using three overlapping consecutive age-specific death rates covering three years each, as coefficient of the B-spline basis defined on a single-year uniformly-spaced knot sequence. The exact expressions of various functions describing the probability distribution of the lifetime are derived from the hazard function. The methods are illustrated using 1981 Canadian male population and death data. Author

N89-13943# State Univ. of New York, Albany.
A LEISURELY LOOK AT THE MODELS OF UNCERTAINTY IN EXPERT SYSTEMS **c65**
Syni-An Hwang *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 359-362 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

Some of the best-known approaches to model the uncertainty in an expert system are studied. There have been papers devoted to similiar topics, Bonissone (1982), and Black and Eddy (1985). One of the aims here is to discuss the points raised by previous papers. Author

N89-13944# Temple Univ., Philadelphia, Pa.
BOOTSTRAPPING KOLMOGOROV-SMIRNOV STATISTICS, 2 **c65**
Alan Julian Izenman *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 363-366 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

This is the second part of an empirical investigation into bootstrapping the two-sample Kolmogorov-Smirnov statistic D(m,n). The first part (ASA, Proc. of the Statistical Computing Section, 97-101, 1985) dealt with estimating the standard error of D(m,n) by bootstrap methods and showed that the bootstrap performs very well, especially when compared with standard asymptotic approximations. Here, an empirical study of percentile estimation for the Kolmogorov-Smirnov statistic using the bootstrap procedure is carried out. As noted for other situations in which percentiles are estimated by the bootstrap, the number of bootstrap replications has to be large to obtain reasonable estimates, and even then those estimates are slightly on the low side. Also considered is a logarithmic transformation of D(m,n), which has been suggested in the literature as having an approximately normal distribution for large m and n. Author

N89-13945# Connecticut Univ., Storrs.
CALCULATING IMPROVED BOUNDS AND APPROXIMATIONS FOR MULTIPLE COMPARISONS **c64**
James R. Kenyon *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 367-371 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

When applying multiple comparison procedures to a particular problem, the simultaneous confidence intervals usually are conservative. This occurs because procedures either use bounds in the coverage probability statement, or project a multivariate region to a multivariate rectangle (i.e., expand a confidence rectangle) (Miller 1981). Even conditional confidence intervals may not have the coverage claimed (Meeks and D'Agostino 1983). Recently, there has been interest in obtaining improvements in bounds for multivariate probabilities (Games 1977, Glaz and Johnson 1984, Miller 1981, and Worsley 1982). It has been shown that the usual, e.g., Bonferroni type bounds, often are not very

useful, particularly when there are many events, or when there is a strong dependence structure in the multivariate distribution (Glaz and Johnson 1984, Miller 1981, Schwager 1984, and Worsley 1982). Three problems are considered for simultaneous confidence intervals and methods are developed to calculate the coverage probability, or improved bounds for this probability. To obtain the approximation for the coverage probability, researchers use several bounds previously developed but not evaluated for these problems, including bounds using a conditional probability approach developed by Glaz and Johnson (1984). Author

N89-13946# Villanova Univ., Pa.
MEASURES OF JOINT INFLUENCE IN REGRESSION: ORTHOGONAL DECOMPOSITION, DISTRIBUTION, AN APPLICATION TO DATA ANALYSIS **c64**
Lillian Kingsbury and Richard M. Heiberger (Temple Univ., Philadelphia, Pa.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 372-376 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

Diagnostic neasures of the joint influence of subsets of data points in regression are easy to define but have lacked an intuitive interpretation. Measures of influence for a single case are easy to interpret in terms of the position of the observation in the spaces spanned by the columns of the X matrix and the (orthogonal) residual column E=Y-Y. An orthogonal decomposition of the joint influence measures in terms of the single case pseudopoints is presented. The decomposition allows an intuitive interpretation of the joint influence measures and leads to the derivation of the distribution of the measures under the usual assumptions. The use of the decomposition in characterizing data configurations which contain influential points and in analysis of data is illustrated. Author

N89-13947# Pennsylvania State Univ., University Park.
A GENERAL TECHNIQUE FOR GENERATING PSEUDO MULTIVARIATE RANDOM VARIABLES: A MARKOV PROCESS APPROACH **c61**
Subhash R. Lele and M. T. Boswell *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 377-380 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A very easy-to-program method of generating random samples from arbitrary discrete or continuous multivariate distributions is presented. A Markov chain is constructed such that its equilibrium distribution is the desired distribution. The observations come from running the process until equilibrium is reached. Author

N89-13948# Zagreb Univ. (Yugoslavia).
INFERENCE IN ROBUST DISCRIMINANT ANALYSIS **c61**
Vesna Luzar *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 381-385 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A procedure for determining asymptotic distribution of the test statistic in a model for robust discriminant analysis is proposed. The expressions, derived for the general class of elliptical populations, were found to be asymptotically distributed as chi squared. A Monte Carlo experiment was conducted in order to study sampling distribution of the proposed statistic. Author

N89-13949# Alaska Univ., Anchorage.
EXACT CONFIDENCE BOUNDS FOR PROPORTIONS **c64**
Donald L. Marx *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 386-389 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

The construction of confidence interval estimates for proportions based on a random sample from an infinite population is one of the earliest inferential techniques learned by statistics users. The normal approximation is so well known that it's accuracy is seldom questioned for samples larger than Size 30. Charts and tables are available for constructing exact confidence bounds for smaller samples. A BASIC computer program for constructing exact confidence bounds is presented here. Following a brief discussion of accepted methods for constructing confidence bounds for proportions a computer algorithm for implementing the exact procedure is described. Inaccuracies of normal approximations are illustrated by several examples presented in the final section. In many cases the approximate procedures realize only one decimal accuracy. Very rarely is the accuracy greater than two decimal places for confidence levels of 95 percent or more and samples of up to 100 observations. Author

N89-13950# Bell Telephone Labs., Inc., Holmdel, N. J.
TUNING COMPUTER SYSTEMS FOR MAXIMUM PERFORMANCE: A STATISTICAL APPROACH
William A. Nazaret and William J. Klingler *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 390-395 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A statistical approach to the problem of setting the tunable parameters of an operating system to minimize response time for interactive tasks is discussed. This approach is applicable to both tuning and benchmarking of computer systems. It is based on the use of statistical experimental design techniques and represents an inexpensive, systematic alternative to traditional ways of improving the response of systems. The method is illustrated by means of experiments performed on VAX minicomputers running under the UNIX System V Operating System. Author

N89-13951# Forest Service, Berkeley, Calif.
FITTING PARAMETRIC AND SEMI-PARAMETRIC PROBIT FORMS WITH NON-ZERO BACKGROUND **c61**
Haiganoush K. Preisler *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 396-401 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The objectives were two-fold. The first was to determine whether insects respond to toxicants in proportion to their body weight. The second was to decide on a mathematical form for the predictor as a function of dose and weight. It was found that the commonly used logarithmic transformation remains appropriate when consideration is extended to a broad family of transformations. Author

N89-13952# Numerical Algorithms Group Ltd., Oxford (England).
ON THE FITTING AND FORECASTING OF VECTOR TIME SERIES MODELS **c61**
B. L. Shea *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 402-404 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The fitting and forecasting of vector time series models is discussed. Minimum mean square error forecasts of future values are computed. Author

N89-13953# University of Southern Illinois, Edwardsville.
PREDICTION INTERVALS FOR THE GAMMA DISTRIBUTION **c61**
Wei-Kei Shiue and Lee J. Bain (Missouri Univ., Rolla.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 405-410 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Approximate prediction intervals for a single future observation or for the average of m future observations are developed for the

two-parameter gamma distribution where both parameters are considered unknown. The methods are illustrated with three examples. Author

N89-13954# Department of Agriculture, Washington, D.C.
COMPUTER-AIDED SURVEY METHODS **c61**
Robert D. Tortora, Frederic A. Vogel, and J. Merrill Shanks (California Univ., Berkeley.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 411-413 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

Computer-assisted survey methods that are being planned, tested, and implemented by the Statistical Reporting Service (SRS) of the U.S. Department of Agriculture for its 44 data collection offices across the United States are described. The major activities include developing a data management system along with computer-aided sampling frame maintenance, computer-aided survey management, and computer assisted telephone interviewing systems. Author

N89-13955# Windsor Univ. (Ontario).
TWO MRPP RANK TESTS AND THEIR SIMULATED POWERS FOR SOME ASYMMETRIC POPULATIONS **c64**
Derrick S. Tracy *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 414-419 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

Two rank tests, based on multiresponse permutation procedure, are compared with respect to their empirical powers, when sampling from underlying Weibull and gamma publications, for different parameters. Simulated powers of the test statistics against various location shifts are examined under Pearson Type III and Type VI distribution approximations. The relative gains in power depend upon the values of the parameter. Author

N89-13956# Michigan Univ., Flint.
SOLUTION OF LEAST SQUARES EQUATIONS BY INCOMPLETE QR FACTORIZATION **c61**
J. W. Trigg and A. K. Rigler (Missouri Univ., Rolla.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 420-423 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The purpose is to suggest that the discretization of the variational problem associated with the differential equation leads to a natural formulation of a rectangular problem solved by an iterative procedure. The process may be applied to more general regression problems and can provide an inner iteration for the nonlinear case. Author

N89-13957# Baylor Univ., Waco, Tex.
POLYHEDRON GRAPHS **c61**
Danny W. Turner, John W. Seaman, and Dean M. Young *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 424-425 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A new multivariate graphical technique known as polyhedron graphics, or P-graphs is introduced. The independent variables are displayed as a polar projection in the base plane of a three-dimensional coordinate system, forming a base polygon. A dependent variable is graphed above the origin of the polar projection. Lines are projected from the plotted dependent variable to the vertices of the base polygon, forming a polyhedron. An additional variable can be plotted below the base plane. Other dependent variables can be represented by moving the base polygon in the base plane, rotating the base polygon, etc. Results of a three-dimensional graphics implementation are presented along with an example from experimental design. Author

N89-13958# Fordham Univ., New York, N.Y.
EFFICIENT ESTIMATION AND TESTING FOR HETEROSCEDASTICITY WITHOUT AUXILIARY VARIABLES **c61**
H. D. Vinod and Aman Ullah (University of Western Ontario, London.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 426-431 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

A new two-step generalized least squares (GLS) estimator which is consistent and asymptotically efficient is proposed. In the first step, a J.N.K. Rao (1973) type modified minimum norm quadratic estimator (MINQE) of the unknown heteroscedastic variances based on replicated observations for the variables in the model is developed. The replicated observations are created in the framework of Vinod's (1982a,b) use of the additional information contained in the fact that only a certain number of digits in the variable data series are reliable, and beyond which there is fuzziness. Latin squares style replications, which are well-known in statistical design of experiments literature (Kendall and Stuart, 1979) are then used. For testing of heteroscedasticity, appropriate test statistics are proposed. Author

N89-13959# General Motors Corp., Warren, Mich.
THE SELECTION OF A STATISTICAL DATA ANALYSIS COMPUTING ENVIRONMENT FOR AN INDUSTRIAL RESEARCH LABORATORY **c61**
James G. Wendelberger and Michael A. Wincek *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 432-437 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The purpose is to briefly state the statistical computing environment (hardware, operating system and application software capabilities) that is necessary for a statistician or an experienced data analyst to efficiently deal with today's problems and to select a currently available environment which best meets the criteria. Because of rapid developments in hardware and software, any selection may very likely be outdated (i.e., able to be improved upon) in three or four years. Hence, it is important to choose extendable software and updateable hardware, both of whose course of growth has been and will continue to be on the state-of-the-art development trajectory. Author

N89-13960# Tuebingen Univ. (West Germany).
AN EXPERT SYSTEM FOR TESTING STATISTICAL HYPOTHESES **c61**
Knut M. Wittkowski *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 438-443 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

Until now, most approaches for building expert systems with applications in statistics have concentrated on the area of generating hypotheses (RX, GUHA-80, REX, STUDENT, GLIM-Front End). These expert systems make decisions on the basis of the empirical distribution of the data, subjective opinion, and some a-priori knowledge. Here, some concepts underlying these systems are proved to be inappropriate for testing statistical hypotheses. Based on a new rating and a new classification of knowledge on statistical concepts, problems and methods and on rules for checking the appropriateness of sub-problems, selection of statistical methods is formalized as a special pattern recognition process. It is demonstrated, how an expert system can support the user in choosing methods and interpreting results. Author

N89-13961# Arizona State Univ., Tempe.
AN EVALUATION OF TIME SERIES ANALYSIS PROGRAMS AVAILABLE IN THREE MAJOR STATISTICAL COMPUTER PACKAGES **c61**
Terry J. Woodfield *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the

Interface 26 Aug. 1987 p 444-449 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

The time series features of BMDP, SAS, and SPSS are considered, and the the packages using simulated data are compared. The results of a small Monte Carlo study comparing three parameter estimation techniques are also presented.

Author

N89-13962# Wisconsin Univ., Madison.
ALGORITHMS FOR NONLINEAR GENERALIZED CROSS-VALIDATION **c61**
Brian S. Yandell *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 450-455 (For primary document see N89-13901 05-60)
(Grants CSRS-511-100; NSF DMS-84-04970)
Avail: NTIS HC A20/MF A01 CSCL 12F

A variety of penalized nonlinear problems can be expressed as the iterated solution to a nonlinear minimization, in which the inner step involves minimizing a penalized weighted least squares expression. Researchers propose algorithms when matrices in the least squares problem may depend on the unknown parameters. The problems in increasing complexity are: (1) generalized linear models, (2) iterated reweighted least squares, and (3) general nonlinear problems. The algorithms are built around GCVPACK (Bates, Lindstrom, Wahba and Yandell, 1985), a package for generalized cross-validation, using a balance of Cholesky and singular value decompositions which is adjusted depending on the type of problem. Author

N89-13963# Systolic Systems, Inc., San Jose, Calif.
COMPUTER ARCHITECTURE FOR KALMAN FILTERING Final Technical Report, 10 Sep. 1987 - 9 Mar. 1988
Richard H. Travassos 9 Mar. 1988 61 p
(Contract DAAD07-87-C-0077)
(AD-A199112) Avail: NTIS HC A04/MF A01 CSCL 17K

Highly parallel architectures are developed to meet the increasing demanding throughput requirements of DOD signal processing applications. To perform multi-dimensional Kalman filtering at sample rates approaching 15 KHz, innovative techniques are presented to partition the problem for real-time implementation. A unique decoupling of the predictor and corrector equations in the Kalman filter is developed to speed up computations by two (2) orders of magnitude (100x). The proposed parallel algorithms and architectures are well suited for recursive filtering, image and signal processing for next generation instrument radar and telemetry equipment. GRA

N89-13964# California Univ., Berkeley. Lawrence Berkeley Lab.
BUILDING A PROTOTYPE EXPERT SYSTEMS
Diane Kalmus, Marjorie Hutchinson, and Dennis Hall Jul. 1988 68 p
(Contract DE-AC03-76SF-00098)
(DE88-016665; LBL-25634) Avail: NTIS HC A04/MF A01

In the past few years expert system technology has been gaining increasing respect within the world of computer science as it offers practical solutions to problems which have previously defied computerization. This paper is the culmination of a years investigation into how LBL can practically make use of this technology to solve some of the problems being faced by its scientists. To establish this and gain a greater understanding of expert system technology we attempted to build a prototype expert system using a commercially available expert system shell. The application we chose was to troubleshoot the hardware of the TPC particle detector (used by high energy physicists at LBL) using Neuron Data's expert system shell, Nexpert. This paper gives some brief overviews of the theoretical and practical work done by other people in fields relevant to this project. It includes: expert systems, their development, diagnostic expert systems, and examples of expert systems built to troubleshoot electronic devices. We describe how we selected our prototype expert system and then how we went about designing and building it. For this we have detailed the knowledge necessary to start troubleshooting the TPC and the methods used to represent that knowledge within the expert system shell. Finally we discuss the understanding of expert system technology which we have gained during this project and why we believe that this technology has a place in the future of problem solving at LBL. DOE

N89-13965# California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Computer Science.
HIGH-BANDWIDTH/LOW LATENCY TEMPORARY STORAGE FOR SUPERCOMPUTERS Ph.D. Thesis
John Alan Swensen Dec. 1987 204 p Sponsored in part by Lawrence Livermore National Laboratories, Calif.
(Contract W-7405-eng-48)
(DE88-016981; UCRL-21106; UCB/CSD-87/383) Avail: NTIS HC A10/MF A01

The traditional use of memory and symmetrical set of registers for storage of temporary results of scientific programs requires more execution time, hardware, and instruction-stream bandwidth than necessary. Novel register organizations that can be easily integrated into traditional supercomputer architectures can reduce all of these requirements. Execution speed can be more than doubled by storing temporary results in an asymmetrical set of general-purpose registers or an asymmetrical set of vector registers instead of in memory and a small register-set. Faster access and a hardware cost one fourth that of traditional vector registers can be had by using a vector register that incorporates a pipelines, random-access-memory chip. If a large enough set of registers is used, the need to store temporary results in memory and then reload them for later use can be eliminated; this saves both instruction-stream bandwidth and execution time. DOE

N89-13966# Los Alamos National Lab., N. Mex.
KNOWLEDGE-BASED SYSTEM FOR COMPUTER SECURITY
William J. Hunteman 1988 13 p Presented at the 11th National Computer Security Conference, Baltimore, Md., 17 Oct. 1988
(Contract W-7405-eng-36)
(DE88-006447; LA-UR-88-648; CONF-881039-1) Avail: NTIS HC A03/MF A01

The rapid expansion of computer security information and technology has provided little support for the security officer to identify and implement the safeguards needed to secure a computing system. The Department of Energy Center for Computer Security is developing a knowledge-based computer security system to provide expert knowledge to the security officer. The system is policy-based and incorporates a comprehensive list of system attack scenarios and safeguards that implement the required policy while defending against the attacks. DOE

N89-13967# Lawrence Livermore National Lab., Calif.
A FRAMEWORK FOR PASSWORD SELECTION
Ana Maria DeAlvare and E. Eugene Schultz, Jr. 1988 15 p Presented at the UNIX Security Workshop, Portland, Oreg., 29 Aug. 1988
(Contract W-7405-eng-48)
(DE88-016281; UCRL-99382; CONF-8808118-1) Avail: NTIS HC A03/MF A01

A major problem in computer security is intrusion into systems due to compromised authentication procedures. This paper focuses on the most commonly used authentication procedure--use of passwords. We have developed a framework for a methodology to estimate the guessability of passwords. We assume that passwords are usually based on a simple rule. If someone discovers one of a series of rule-based passwords, it is easier to guess other passwords. The framework we propose is that computer security experts can conduct guessability studies on a large number of passwords which are candidates for assignment to users. People who attempt to guess what a password is can be provided with cues, such as what a password for another account in the system is or a nickname. Hit rates (the percentage of passwords correctly guessed within a limited number of attempts) can then be obtained.

This method can be used to develop metrics for guessability of classes of passwords. A system manager might utilize results of guessability studies by encouraging users to avoid choosing passwords which are closely associated with account names or which have been shown to be highly vulnerable to guessing, or by not assigning passwords which are from vulnerable classes of passwords. A pilot study confirmed the feasibility of this framework. Participants were given 20 attempts to guess an eight-character password which was either a common English word or two unrelated words joined by a control character (eight characters in all). The common English word was vulnerable to guessing, but only when cues about this word were provided. Participants never guessed the other password, however, even when cues were provided. The results not only demonstrate feasibility of our framework, but also suggest guidelines for selecting passwords which are less likely to result in compromised authentication procedures. DOE

N89-13968# Oak Ridge National Lab., Tenn. Engineering Physics and Mathematics Div.

DETERMINISTIC SENSITIVITY AND UNCERTAINTY ANALYSIS FOR LARGE-SCALE COMPUTER MODELS

B. A. Worley, F. G. Pin, E. M. Oblow, R. E. Maerker, J. E. Horwedel, and R. Q. Wright 1988 22 p Presented at the Annual DOE Low-Level Waste Management Conference, Denver, Colo., 30 Aug. 1988

(Contract DE-AC05-84OR-21400)

(DE88-016785; CONF-880839-3) Avail: NTIS HC A03/MF A01

This paper presents a comprehensive approach to sensitivity and uncertainty analysis of large-scale computer models that is analytic (deterministic) in principle and that is firmly based on the model equations. The theory and application of two systems based upon computer calculus, GRESS and ADGEN, are discussed relative to their role in calculating model derivatives and sensitivities without a prohibitive initial manpower investment. Storage and computational requirements for these two systems are compared for a gradient-enhanced version of the PRESTO-II computer model. A Deterministic Uncertainty Analysis (DUA) method that retains the characteristics of analytically computing result uncertainties based upon parameter probability distributions is then introduced and results from recent studies are shown. DOE

N89-13969# Naval Postgraduate School, Monterey, Calif.

DESIGN, IMPLEMENTATION, BUILDING AND EVALUATION OF A TORUS DOUBLE TRANSITIVE CLOSURE NETWORK OF TRANSPUTERS M.S. Thesis

Jose I. FrazaoSasa Jun. 1988 169 p

(AD-A198392) Avail: NTIS HC A08/MF A01 CSCL 12F

Currently the design of highly parallel supercomputers is one of the most challenging problems in engineering. The purpose of this thesis is to describe how the problem was approached in the design, implementation and building of a Torus Double Transitive Closure Network of Microprocessors, using the T414 Transputer as the basic Unit of Computation. Also compares the performance of the evolved model, from one Transputer to the final stage of sixteen Transputers running in parallel. All the programs and examples presented in this thesis were implemented in the OCCAM2 Programming Language, using the Transputer Development System, D700c, BETA 2.0 release March 1987 compiler version. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N89-13970# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

IMPLEMENTATION OF A MIXED INTEGER PROGRAMMING MODEL FOR THE WAREHOUSE LOCATION PROBLEM [IMPLEMENTACAO DE UM MODELO DE PROGRAMACAO INTEIRA MISTA PARA O PROBLEMA DE LOCALIZACAO DE ARMAZENS]

Acioli Antonio deOlivo, Hugo Rosenthal, and Osvaldo Jose DalFabro Aug. 1988 9 p In PORTUGUESE; ENGLISH summary Presented at the ENEGEP 7 - National Meeting on Production Engineering, Sao Carlos, Brazil, 6-9 Sep. 1988

(INPE-4682-PRE/1377) Avail: NTIS HC A02/MF A01

A mixed integer formulation is presented for the capacitated warehouse location problem. The model was tested for a network with 24 nodes and the solution was calculated with the LINDO/PC SYSTEM, using a compatible microcomputer IBM-PC. Author

N89-13971# Naval Postgraduate School, Monterey, Calif.

ANALYSIS OF AN IMAGE PROCESSING ALGORITHM FOR ITS IMPLEMENTATION IN REAL TIME M.S. Thesis

Roberto M. Ventura Mar. 1988 50 p

(AD-A197225) Avail: NTIS HC A03/MF A01 CSCL 12E

This thesis deals with the implementation and analysis of an image processing algorithm in order to determine the feasibility of its operation in a real time environment at standard video frame rates. A modification of the Peli and Lim algorithm has been put to work in processing images taken from a submerged camera operating in turbid water environments with uneven light distribution. The algorithm's performance was observed in detail to determine if it met the required specifications. Through analysis, the algorithm's intense computational requirements and large memory storage demands were resolved. It was determined that for the algorithms to operate in real time, a system with characteristics of a supercomputer would most likely be needed. The algorithm was transported to an IBM AT equipped for image processing. Possible optimization techniques were discussed briefly, and other solutions for processing images with this type of equipment were suggested. GRA

N89-13972# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

SUBLINEAR-TIME PARALLEL ALGORITHMS FOR MATCHING AND RELATED PROBLEMS

Andrew V. Goldberg, Serge A. Plotkin, and Pravin Vaidya Jul. 1988 29 p

(Contracts N00014-87-K-0825; N00014-86-K-0593)

(AD-A197411; MIT/LCS/TM-357) Avail: NTIS HC A03/MF A01 CSCL 12G

This paper presents the first sublinear-time deterministic parallel algorithms for bipartite matching and several related problems, including maximal node-disjoint paths, depth-first search, and flows in zero-one networks. Our results are based on a better understanding of the combinatorial structure of the above problems, which leads to new algorithmic techniques. In particular, we show how to use maximal matching to extend, in parallel, a current set of node-disjoint paths and how to take advantage of the parallelism that arises when a large number of nodes are active during an execution of a push/relabel network flow algorithm. We also show how to apply our techniques to design parallel algorithms for the weighted versions of the above problems. In particular, we present sublinear-time deterministic parallel algorithms for dining a minimum-weight bipartite matching and for finding a minimum-cost flow in a network with zero-one capacities, if the weights are polynomially bounded integers. GRA

N89-13973# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
A GUIDE TO THE ASSESSMENT OF SOFTWARE DEVELOPMENT METHODS Final Technical Report
Bill Wood, Richard Pethia, Lauren R. Gold, and Robert Firth Apr. 1988 43 p
(Contract F19628-85-C-0003)
(AD-A197416; CMU/SEI-88-TR-8; ESD-TR-88-009) Avail: NTIS HC A03/MF A01 CSCL 12E

Over the past decade, the term software engineering method has been attached to a variety of procedures and techniques that attempt to provide an orderly, systematic way of developing software. Existing methods approach the task of software engineering in different ways. Deciding which methods to use to reduce development costs and improve the quality of produced products is a difficult task. This report outlines a five step process and an organized set of questions that provide method assessors with a systematic way to improve their understanding and form opinions on the ability of existing methods to meet their organization's needs: (1) Needs analysis; (2) Constraint identification, (3) User requirements, (4) Management requirements, and (5) Introduction plan. GRA

N89-13974*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TECHNIQUE FOR SOLVING CONSTRAINT SATISFACTION PROBLEMS USING PROLOG'S DEFINITE CLAUSE GRAMMARS
Philip R. Nachtsheim Oct. 1988 13 p
(NASA-TM-101031; A-88286; NAS 1.15:101031) Avail: NTIS HC A03/MF A01 CSCL 09B

A new technique for solving constraint satisfaction problems using Prolog's definite clause grammars is presented. It exploits the fact that the grammar rule notation can be viewed as a state exchange notation. The novel feature of the technique is that it can perform informed as well as blind search. It provides the Prolog programmer with a new technique for application to a wide range of design, scheduling, and planning problems. Author

N89-13975*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
USING DATA TAGGING TO IMPROVE THE PERFORMANCE OF KANERVA'S SPARSE DISTRIBUTED MEMORY
David Rogers 1 Jan. 1988 34 p
(Contract NCC2-408)
(NASA-CR-184557; RIACS-TR-88.1; NAS 1.26:184557) Avail: NTIS HC A03/MF A01 CSCL 09B

The standard formulation of Kanerva's sparse distributed memory (SDM) involves the selection of a large number of data storage locations, followed by averaging the data contained in those locations to reconstruct the stored data. A variant of this model is discussed, in which the predominant pattern is the focus of reconstruction. First, one architecture is proposed which returns the predominant pattern rather than the average pattern. However, this model will require too much storage for most uses. Next, a hybrid model is proposed, called tagged SDM, which approximates the results of the predominant pattern machine, but is nearly as efficient as Kanerva's original formulation. Finally, some experimental results are shown which confirm that significant improvements in the recall capability of SDM can be achieved using the tagged architecture. Author

N89-13976*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ORGANIZATION OF AN AUTONOMOUS LEARNING SYSTEM
Pentti Kanerva May 1988 24 p Submitted for publication
Sponsored in part by System Development Foundation
(Contract NCC2-408)
(NASA-CR-184556; RIACS-TR-88.14; NAS 1.26:184556) Avail: NTIS HC A03/MF A01 CSCL 09B

The organization of systems that learn from experience is examined, human beings and animals being prime examples of such systems. How is their information processing organized. They build an internal model of the world and base their actions on the model. The model is dynamic and predictive, and it includes the systems' own actions and their effects. In modeling such systems, a large pattern of features represents a moment of the system's experience. Some of the features are provided by the system's senses, some control the system's motors, and the rest have no immediate external significance. A sequence of such patterns then represents the system's experience over time. By storing such sequences appropriately in memory, the system builds a world model based on experience. In addition to the essential function of memory, fundamental roles are played by a sensory system that makes raw information about the world suitable for memory storage and by a motor system that affects the world. The relation of sensory and motor systems to the memory is discussed, together with how favorable actions can be learned and unfavorable actions can be avoided. Results in classical learning theory are explained in terms of the model, more advanced forms of learning are discussed, and the relevance of the model to the frame problem of robotics is examined. Author

N89-13977*# Stanford Univ., Calif. Computer Systems Lab.
SPARSE DISTRIBUTED MEMORY PROTOTYPE: PRINCIPLES OF OPERATION
Michael J. Flynn, Pentti Kanerva, Bahram Ahanin, Neal Bhadkamkar, Paul Flaherty, and Philip Hickey Feb. 1988 95 p
(Grant NAGw-419)
(NASA-CR-184554; NAS 1.26:184554; CSL-TR-87-338)
Copyright Avail: NTIS HC A05/MF A01 CSCL 09B

Sparse distributed memory is a generalized random access memory (RAM) for long binary words. Such words can be written into and read from the memory, and they can be used to address the memory. The main attribute of the memory is sensitivity to similarity, meaning that a word can be read back not only by giving the original right address but also by giving one close to it as measured by the Hamming distance between addresses. Large memories of this kind are expected to have wide use in speech and scene analysis, in signal detection and verification, and in adaptive control of automated equipment. The memory can be realized as a simple, massively parallel computer. Digital technology has reached a point where building large memories is becoming practical. The research is aimed at resolving major design issues that have to be faced in building the memories. The design of a prototype memory with 256-bit addresses and from 8K to 128K locations for 256-bit words is described. A key aspect of the design is extensive use of dynamic RAM and other standard components. Author

N89-13978# Stanford Univ., Calif. Knowledge Systems Lab.
FIRMWARE APPROACH TO FAST LISP INTERPRETER
Hiroshi G. Okuno, Nobuyasu Osato, and Ikuo Takeuchi Sep. 1987 27 p
(Contract F30602-85-C-0012)
(AD-A198673; KSL-87-57; SU-STAN-CS-87-1184) Avail: NTIS HC A03/MF A01 CSCL 12E

The approach to speed up a Lisp interpreter by implementing it in firmware seems promising. A microcoded Lisp interpreter shows good performance for very simple benchmarks, while it often fails to provide good performance for larger benchmarks and applications unless speedup techniques are devised for it. This was the case for the TAO/ELIS system. This paper describes various techniques devised for the TAO/ELIS system in order to speed up the interpreter of the TAO language implemented on the ELIS Lisp machine. The techniques include data type dispatch, variable access, function call and so on. TAO is not only upward compatible with Common Lisp, but also incorporates logic programming, object-oriented programming and FORTRAN/C-like programming into Lisp programming. TAO also provides concurrent programming and supports multiple users (up to eight users). The TAO interpreter for those programming paradigms is coded fully in microcodes. In spite of rich functionalities, the speed of interpreted codes of TAO is comparable to that of compiled codes of commercial Lisp machines. Furthermore, the speeds of the

interpreted codes of the same program written in various programming paradigms in TAO does not differ so much. This speed balance is very important for the user. GRA

N89-13979# Yale Univ., New Haven, Conn. Dept. of Computer Science.
FROM BAREISS' ALGORITHM TO THE STABLE COMPUTATION OF PARTIAL CORRELATIONS Research Report
Jean-Marc Delosme and Ilse C. Ipsen May 1988 23 p
(Contracts N00014-85-K-0461; N00014-86-K-0310; DAAL03-86-K-0158)
(AD-A198696; YALEU/DCS/RR-624) Avail: NTIS HC A03/MF A01 CSCL 12C

This paper presents the derivation of a new algorithm for the stable computation of sample partial correlation coefficients. The authors start with Bareiss' algorithm for the solution of linear system of equations with (nonsymmetric) Toeplitz coefficient matrix and show how to generalize it to matrices that are not Toeplitz. The so generalized Bareiss algorithm computes the LU and UL factorizations of those matrices whose contiguous principal submatrices are all non-singular. For symmetric positive-definite matrices A, which naturally satisfy this condition, the normalized version of Bareiss' algorithm is just the Hyperbolic Cholesky algorithm, which computes the upper and lower triangular Cholesky factors U and L of A by means of 2 x 2 hyperbolic rotations. Guided by the data flow graph of the Hyperbolic Cholesky algorithm, we show that there exists one sequence of 2 x 2 orthogonal rotations that effects the transformation from U to L such that the sines of these rotations equal the hyperbolic tangents of the hyperbolic rotations. From the connection to the Hyperbolic Cholesky algorithm it also follows that, if A is a sample covariance matrix, the sines ar sample partial correlation coefficients. GRA

N89-13980# National Bureau of Standards, Gaithersburg, Md. Software Standards Validation Group.
Ada (TRADEMARK) COMPILER VALIDATION SUMMARY REPORT: CERTIFICATE NUMBER 871209S1.09015, DIGITAL EQUIPMENT CORPORATION VAX Ada, VERSION 1.5. HOST: VAX 8800 UNDER VAX/VMS, VERSION 4.7. TARGET: MICROVAX II UNDER VAXELN TOOLKIT, VERSION 3.0 IN COMBINATION WITH VAXELN Ada, VERSION 1.2
9 Dec. 1987 72 p
(AD-A198881; NBS-87VDEC540-2) Avail: NTIS HC A04/MF A01 CSCL 12E

This Report describes the extent to which a specific Ada compiler conforms to the Ada, Standard, ANSI/MIL-STD-1815A. This report explains all technical terms used within it and thoroughly reports the results of testing this compiler using the Ada Compiler Validation Capability (ACVC). An Ada compiler must be implemented according to the Ada Standard, and any implementation-dependent features must conform to the requirements of the Ada Standard. The Ada Standard must be implemented in its entirety. Even though all validated Ada compilers conform to the Ada Standard, it must be understood that some differences do exist between implementations. The Ada Standard permits some implementation dependencies--for example, the maximum length of identifiers or the maximum values of integer types. Other differences between compilers result from the characteristics of particular operating systems, hardware, or implementation strategies. All the dependencies observed during the process of testing this compiler are given in this report. This information in this report is derived from the test results produced during validation testing. The validation process includes submitting a suite of standardized tests, the ACVC, as inputs to an Ada compiler and evaluating the results. GRA

N89-13981# Stanford Univ., Calif. Systems Optimization Lab.
A PRACTICAL ANTI-CYCLING PROCEDURE FOR LINEAR AND NONLINEAR PROGRAMMING
Philip E. Gill, Walter Murray, Michael A. Saunders, and Margaret H. Wright Jul. 1988 34 p
(Contracts N00014-87-K-0142; DE-FG03-87ER-25030; NSF CCR-84-13211; NSF ECS-87-15153; AF-AFOSR-0916-87)
(AD-A198943; SU-SOL-88-4) Avail: NTIS HC A03/MF A01 CSCL 12D

A new method is given for preventing the simplex method from cycling. Key features are that a positive step is taken at every iteration, and nonbasic variables are allowed to be slightly infeasible. There is no additional work per iteration. Computational results are given for the first 53 test problems in netlib, indicating reliable performance in all cases. The method may be applied to active-set methods for solving nonlinear programs with linear constraints. GRA

N89-13982# Stanford Univ., Calif. Systems Optimization Lab.
INTERIOR-POINT METHODS FOR LINEAR PROGRAMMING: A CHALLENGE TO THE SIMPLEX METHOD
Philip E. Gill, Walter Murray, and Michael A. Saunders Jul. 1988 17 p
(Contracts N00014-87-K-0142; DE-FG03-87ER-25030; NSF CCR-84-13211; NSF ECS-87-15153; AF-AFOSR-0196-87)
(AD-A198944; SU-SOL-88-14) Avail: NTIS HC A03/MF A01 CSCL 12D

The world of mathematical programming has seen a remarkable surge of activity following publication of Karmarkar's projective algorithm in May 1984. A review of the ensuing three years has already appeared. One year later, the authors review some of the main methods and surrounding events, and focus on references that contain computational results. GRA

N89-13983# Sandia National Labs., Albuquerque, N. Mex.
MODLPAT USER GUIDE LINKING STRUCTURAL DYNAMIC TEST AND ANALYSIS CODES
Phyllis K. Metzler, David R. Martinez, and Jim P. Lauffer Aug. 1988 57 p
(Contract DE-AC04-76DP-00789)
(DE88-016853; SAND-87-2295) Avail: NTIS HC A04

MODLPAT is an interactive program which permits the exchange of structural model and response information between the structural dynamic analysis and testing groups. The code was initially written as a translator between MODAL-PLUS and PATRAN, providing the capability to transfer geometry, connectivity, and deformed structure information. This permits the simultaneous display of animated mode shapes from test and analysis. Other utilities exist in the code to apply a coordinate system rotation, translation (i.e., shift), and scaling to the test model geometry and deformed shapes, and to normalize and concatenate deformed shape files. This link between test and analysis eliminates duplication of effort and permits the efficient transfer of structural model and response data. MODLPAT also contains a translator from MODAL-PLUS to PRO-MATLAB, providing the capability to perform interactive dynamic systems analysis calculations with the test data. Other possibilities being considered for MODLPAT are to include it as part of a general package providing the capability to transfer information among all the dynamic test and analysis codes, including: PRO-MATLAB, PATRAN, MODAL-PLUS, NASTRAN, and other system synthesis and analysis codes. This would provide one of the tools necessary for incorporating test-derived modal models directly into analysis codes using component mode synthesis techniques, as well as simplify the transfer of information required to perform test/analysis correlation studies. DOE

N89-13984*# Alabama Univ., Huntsville. Research Center.
A NATURAL LANGUAGE INTERFACE TO DATABASES Final Report
D. R. Ford Oct. 1988 10 p
(Grant NAG8-641)
(NASA-CR-184570; NAS 1.26:184570; UAH-RR-751) Avail: NTIS HC A02/MF A01 CSCL 09B

The development of a Natural Language Interface which is semantic-based and uses Conceptual Dependency representation is presented. The system was developed using Lisp and currently runs on a Symbolics Lisp machine. A key point is that the parser

handles morphological analysis, which expands its capabilities of understanding more words. Author

N89-13985*# Alabama Univ., Huntsville. Dept. of Psychology.
LANGUAGES FOR ARTIFICIAL INTELLIGENCE: IMPLEMENTING A SCHEDULER IN LISP AND IN Ada Final Report
Dan Hays Oct. 1988 92 p
(Grant NAG8-641)
(NASA-CR-184571; NAS 1.26:184571; UAH-RR-752) Avail: NTIS HC A05/MF A01 CSCL 09B

A prototype scheduler for space experiments originally programmed in a dialect of LISP using some of the more traditional techniques of that language, was recast using an object-oriented LISP, Common LISP with Flavors on the Symbolics. This object-structured version was in turn partially implemented in Ada. The Flavors version showed a decided improvement in both speed of execution and readability of code. The recasting into Ada involved various practical problems of implementation as well as certain challenges of reconceptualization in going from one language to the other. Advantages were realized, however, in greater clarity of the code, especially where more standard flow of control was used. This exercise raised issues about the influence of programming language on the design of flexible and sensitive programs such as schedule planners, and called attention to the importance of factors external to the languages themselves such as system embeddedness, hardware context, and programmer practice. Author

N89-13986# Naval Surface Weapons Center, Dahlgren, Va.
INTEGRATION OF THE TRIVARIATE NORMAL DISTRIBUTION OVER AN OFFSET SPHERE AND AN INVERSE PROBLEM Final Report
Armido R. DiDonato Feb. 1988 85 p
(AD-A198129; NSWC-TR-87-27) Avail: NTIS HC A05/MF A01 CSCL 12C

A numerical procedure is given for evaluating P (the kill probability) the integral of the trivariate normal distribution over an offset sphere of radius R. A numerical algorithm is also described for computing R when P is given. The procedures generally give P or R to six decimal digits. Program listings in HP BASIC, for the HP 9845B computer, are included. GRA

N89-13987# Indiana Univ., Bloomington. Dept. of Chemistry.
TOMOGRAPHIC IMAGE RECONSTRUCTION TECHNIQUES FOR SPECTROSCOPIC SOURCES: THEORY AND COMPUTER SIMULATIONS
C. A. Monnig, K. A. Marshall, G. D. Rayson, and Gary M. Hieftje 11 Jul. 1988 31 p
(Contract N00014-86-K-0366)
(AD-A198213; INDU/DC/GMH/TR-88-36) Avail: NTIS HC A03/MF A01 CSCL 20I

Computerized tomography (CT) offers one method for accurately reconstructing the spatial features of a spectroscopic source having arbitrary geometry. With computer-simulated lateral projections as the input data, the potential advantages and problems associated with several CT algorithms were compared. In general, CT offers greater spatial information content than more commonly used image-reconstruction techniques, but at the added expense of more involved post-processing calculations and more elaborate experimental instrumentation. GRA

N89-13988# Indiana Univ., Bloomington. Dept. of Chemistry.
QUANTILE ANALYSIS: A METHOD FOR CHARACTERIZING DATA DISTRIBUTIONS
Robert A. Lodder and Gary M. Hieftje 11 Jul. 1988 41 p
(Contract N00014-86-K-0366)
(AD-A198215; INDU/DC/GMH/TR-37) Avail: NTIS HC A03/MF A01 CSCL 12C

Analyzing distributions of data represents a common problem in analytical chemistry. Quantile-quantile (QQ) plots provide a useful way to attack this problem. These graphs are often used in the form of the normal probability plot, to determine if the residuals from a fitting process are randomly distributed and therefore whether an assumed model fits the data at hand. By comparing the integrals of two probability density functions in a single plot, QQ plotting methods are able to capture the location, scale, and skew of a data set. This procedure provides more information to the analyst than classical statistical methods that rely on a single test statistic for distribution comparisons. GRA

N89-13989# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
A LATTICE-STRUCTURED PROOF TECHNIQUE APPLIED TO A MINIMUM SPANNING TREE ALGORITHM
Jennifer Lundelius Welch, Leslie Lamport (Digital Equipment Corp., Maynard, Mass.), and Nancy Lynch Jun. 1988 199 p
(Contracts N00014-85-K-0168; N00014-83-K-0125; NSF CCR-86-11442)
(AD-A198312; MIT/LCS/TM-361) Avail: NTIS HC A09/MF A01 CSCL 12B

Highly-optimized concurrent algorithms are often hard to prove correct because they have no natural decomposition into separately provable parts. This paper presents a proof technique for the modular verification of such non-modular algorithms. It generalizes existing verification techniques based on a totally-ordered hierarchy of refinements to allow a partially-ordered hierarchy-that is, a lattice of different views of the algorithm. The technique is applied to the well-known distributed minimum spanning tree algorithm of Gallager, Humblet and Spira, which was until recently lacked a rigorous proof. GRA

N89-13990# Johns Hopkins Univ., Laurel, Md. Applied Physics Lab.
EVALUATION METHODOLOGY FOR SOFTWARE ENGINEERING Final Report, 1 Jun. 1987 - 31 May 1988
Bruce I. Blum 31 May 1988 14 p
(Grant AF-AFOSR-0219-87; AF Proj. 2304)
(AD-A198398; APL/JHU/RMI-88-007; AFOSR-88-0791TR) Avail: NTIS HC A03/MF A01 CSCL 12E

The topic of this research involves two categories of investigation. One centers on the methods used for evaluation in the various scientific disciplines. The principal investigator is studying these methods, but the research is not yet to the point that a unifying paper directed to the software engineering problem can be produced. The second area of investigation is that of the software process and what can be evaluated with respect to it. In this domain, work progress through small experiments and conceptual studies. Considerable accomplishments have been reported for the first year of research. There is every reason to believe that this progress will continue in the remaining two years of study and that some unified theory for process evaluation will evolve. GRA

N89-13991*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A STRATEGY FOR REDUCING TURNAROUND TIME IN DESIGN OPTIMIZATION USING A DISTRIBUTED COMPUTER SYSTEM
Katherine C. Young, Sharon L. Padula, and James L. Rogers Oct. 1988 10 p Presented at the ASME Design Technology Conferences-The Design Automation Conference, Kissimmee, Fla., 25-28 Sep. 1988
(NASA-TM-101519; NAS 1.15:101519) Avail: NTIS HC A02/MF A01 CSCL 09B

There is a need to explore methods for reducing lengthly computer turnaround or clock time associated with engineering design problems. Different strategies can be employed to reduce this turnaround time. One strategy is to run validated analysis software on a network of existing smaller computers so that portions of the computation can be done in parallel. This paper focuses on the implementation of this method using two types of problems. The first type is a traditional structural design optimization problem, which is characterized by a simple data flow and a complicated analysis. The second type of problem uses an existing computer program designed to study multilevel optimization

techniques. This problem is characterized by complicated data flow and a simple analysis. The paper shows that distributed computing can be a viable means for reducing computational turnaround time for engineering design problems that lend themselves to decomposition. Parallel computing can be accomplished with a minimal cost in terms of hardware and software. Author

N89-13992*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A STUDY OF THE USE OF LINEAR PROGRAMMING TECHNIQUES TO IMPROVE THE PERFORMANCE IN DESIGN OPTIMIZATION PROBLEMS
Katherine C. Young and Jaroslaw Sobieszczanski-Sobieski Oct. 1988 5 p
(NASA-TM-101520; NAS 1.15:101520) Avail: NTIS HC A02/MF A01 CSCL 09B

This project has two objectives. The first is to determine whether linear programming techniques can improve performance when handling design optimization problems with a large number of design variables and constraints relative to the feasible directions algorithm. The second purpose is to determine whether using the Kreisselmeier-Steinhauser (KS) function to replace the constraints with one constraint will reduce the cost of total optimization. Comparisons are made using solutions obtained with linear and non-linear methods. The results indicate that there is no cost saving using the linear method or in using the KS function to replace constraints. Author

N89-13993*# Ohio State Univ., Columbus. ElectroScience Lab.
ENGINEERING CALCULATIONS FOR SOLVING THE ORBITAL ALLOTMENT PROBLEM
C. Reilly, E. K. Walton, C. Mount-Campbell, R. Caldecott, E. Aebker, and F. Mata Aug. 1988 36 p
(Grant NAG3-159)
(NASA-CR-184607; NAS 1.26:184607; ESL-718688-7) Avail: NTIS HC A03/MF A01 CSCL 09B

Four approaches for calculating downlink interferences for shaped-beam antennas are described. An investigation of alternative mixed-integer programming models for satellite synthesis is summarized. Plans for coordinating the various programs developed under this grant are outlined. Two procedures for ordering satellites to initialize the k-permutation algorithm are proposed. Results are presented for the k-permutation algorithms. Feasible solutions are found for 5 of the 6 problems considered. Finally, it is demonstrated that the k-permutation algorithm can be used to solve arc allotment problems. Author

N89-13994*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ESTIMATION ERROR COVARIANCE MATRIX FOR THE IDEAL STATE RECONSTRUCTOR WITH MEASUREMENT NOISE
Michael E. Polites Dec. 1988 19 p
(NASA-TP-2881; NAS 1.60:2881) Avail: NTIS HC A03/MF A01 CSCL 09B

A general expression is derived for the state estimation error covariance matrix for the Ideal State Reconstructor when the input measurements are corrupted by measurement noise. An example is presented which shows that the more measurements used in estimating the state at a given time, the better the estimator. Author

N89-13995*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE ENVIRONMENT FOR APPLICATION SOFTWARE INTEGRATION AND EXECUTION (EASIE), VERSION 1.0. VOLUME 2: PROGRAM INTEGRATION GUIDE
Kennie H. Jones, Donald P. Randall, Scott S. Stallcup (Computer Sciences Corp., Hampton, Va.), and Lawrence F. Rowell Dec. 1988 121 p
(NASA-TM-100574; NAS 1.15:100574) Avail: NTIS HC A06/MF A01 CSCL 09B

The Environment for Application Software Integration and Execution, EASIE, provides a methodology and a set of software utility programs to ease the task of coordinating engineering design and analysis codes. EASIE was designed to meet the needs of conceptual design engineers that face the task of integrating many stand-alone engineering analysis programs. Using EASIE, programs are integrated through a relational data base management system. In volume 2, the use of a SYSTEM LIBRARY PROCESSOR is used to construct a DATA DICTIONARY describing all relations defined in the data base, and a TEMPLATE LIBRARY. A TEMPLATE is a description of all subsets of relations (including conditional selection criteria and sorting specifications) to be accessed as input or output for a given application. Together, these form the SYSTEM LIBRARY which is used to automatically produce the data base schema, FORTRAN subroutines to retrieve/store data from/to the data base, and instructions to a generic REVIEWER program providing review/modification of data for a given template. Automation of these functions eliminates much of the tedious, error prone work required by the usual approach to data base integration. Author

N89-13996*# MARC Analysis Research Corp., Palo Alto, Calif.
MHOST VERSION 4.2. VOLUME 1: USERS' MANUAL
Shohei Nakazawa [1989] 135 p
(Contract NAS3-23697)
(NASA-CR-182235; NAS 1.26:182235) Avail: NTIS HC A07/MF A01 CSCL 09B

This manual describes the user options available for running the MHOST finite element analysis package. MHOST is a solid and structural analysis program based on mixed finite element technology, and is specifically designed for three-dimensional inelastic analysis. A family of two- and three-dimensional continuum elements along with beam and shell structural elements can be utilized. Many options are available in the constitutive equation library, the solution algorithms and the analysis capabilities. An overview of the algorithms, a general description of the input data formats, and a discussion of input data for selecting solution algorithms are given. Author

N89-13902# Maryland Univ., College Park. Dept. of Computer Science.
COMMUNICATION IN PARALLEL ALGORITHMS: AN EXAMPLE
G. W. Stewart *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 11-14 (For primary document see N89-13901 05-60)
(Grant AF-AFOSR-0078-82)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13903# Cornell Univ., Ithaca, N.Y.
MATRIX COMPUTATIONS, SIGNAL PROCESSING AND SYSTOLIC ARRAYS
Franklin T. Luk *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 15-19 (For primary document see N89-13901 05-60)
(Contract N00014-85-K-0074)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13906# Texas Univ., Austin.
MacSpin: GRAPHICAL DATA ANALYSIS
Andrew W. Donoho, David L. Donoho, and Miriam Gasko (Chicago Univ., Ill.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 59-62 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13907# Bell Telephone Labs., Inc., Murray Hill, N. J.
GRAP: A LANGUAGE FOR STATISTICAL DISPLAYS
Jon L. Bentley and Brian W. Kernighan *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th

Symposium on the Interface 26 Aug. 1987 p 63-68 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13910# Language of Data Project, Sausalito, Calif.
TABLES AND GRAPHS AS LANGUAGE
Nancy Clark, ed. *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 83-89 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13911# RAND Corp., Santa Monica, Calif.
IMPLICATIONS OF THE LANGUAGE OF DATA FOR COMPUTING SYSTEMS
William H. Rogers *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface . 26 Aug. 1987 p 90-95 Prepared in cooperation with Language of Data Project, Sausalito, Calif. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13912# San Jose State Univ., Calif.
THE LANGUAGE OF DATA: A GENERAL THEORY OF DATA
James L. Dolby, Nancy Clark, ed., and William H. Rogers (RAND Corp., Santa Monica, Calif.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 96-103 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13913# San Jose State Univ., Calif.
INTELLIGENT DATA MANAGEMENT
Henson Graves and Ruth Manor *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 104-109 Prepared in cooperation with Tel-Aviv Univ., Israel (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13914# Imperial Coll. of Science and Technology, London (England).
A FRONT-END FOR GLIM
J. A. Nelder and D. Wolstenholme *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 113-117 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13917# California Univ., Los Angeles.
INFERENCE FROM COARSE DATA USING MULTIPLE IMPUTATION
Daniel F. Heitjan and Donald B. Rubin (Harvard Univ., Cambridge, Mass.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 138-143 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13919# Chicago Univ., Ill.
TOOLS FOR DATA ANALYSIS MANAGEMENT
Ronald A. Thisted *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 152-159 (For primary document see N89-13901 05-60)
(Grant NSF DMS-84-12233)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13920# Massachusetts Inst. of Tech., Cambridge.
STATISTICALLY SOPHISTICATED SOFTWARE AND DINDE
R. W. Oldford and S. C. Peters *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 160-167 (For primary document see N89-13901 05-60)
(Grant NSF IST-84-20614)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13922# Rochester Univ., N. Y.
INTERACTIVE COLOR GRAPHIC DISPLAY OF DATA BY 3-D BIPLOTS
K. Ruben Gabriel, Anup Basu, Charles L. Odoroff, and Terry M. Therneau *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 175-178 (For primary document see N89-13901 05-60)
(Contract N00014-80-C-0837)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13923# Oak Ridge National Lab., Tenn.
ALGORITHMS FOR BAYESIAN VARIABLE SELECTION IN REGRESSION
Toby J. Mitchell and John J. Beauchamp *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 181-182 Previously announced as N86-33094 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13925# Kentucky Univ., Lexington.
A STATISTICAL LANGUAGE FOR MICROCOMPUTERS
David M. Allen *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 233-235 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13926# Illinois State Univ., Normal.
MATRIX LANGUAGES FOR STATISTICS
Kenneth N. Berk *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 236-243 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13927# Ottawa Univ. (Ontario).
PUBLISHING STATISTICAL SOFTWARE
John C. Nash *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 244-247 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13928# AT and T Information Systems Labs., Denver, Colo.
ESTIMATION OF RESPONSE TIME CHARACTERISTICS IN PRIORITY QUEUEING NETWORKS VIA AN INTERPOLATION METHODOLOGY BASED ON SIMULATION AND HEAVY TRAFFIC LIMITS
B. Simon and J. S. Willie *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 251-256 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13929# Bell Telephone Labs., Inc., Murray Hill, N. J.
ON SOME STATISTICAL ISSUES IN SIMULATION STUDIES
C. L. Mallows and V. N. Nair *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 261-264 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13930# Toronto Univ. (Ontario).
BOOTSTRAP CONFIDENCE INTERVALS
Robert Tibshirani *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 267-273 Sponsored in part by the

Natural Sciences and Engineering Research Council of Canada (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13931# Bell Telephone Labs., Inc., Murray Hill, N. J.
MAXIMUM LIKELIHOOD AND QUASI-LIKELIHOOD FOR NONLINEAR EXPONENTIAL FAMILY MODELS
David M. Gay and Roy E. Welsch (Massachusetts Inst. of Tech., Cambridge.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 277-284 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13932# National Bureau of Standards, Washington, D.C.
AN EFFICIENT ALGORITHM FOR ORTHOGONAL DISTANCE DATA FITTING
Paul T. Boggs, Richard H. Byrd, and Robert B. Schnabel (Colorado Univ., Boulder.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 285-293 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13933# Minnesota Univ., Duluth.
THE APPLICATION OF CONVEX HULLS IN MULTIPLE DIMENSIONS
Max Benson, Kinley Larntz, Michael Lavine (Minnesota Univ., Saint Paul.), and Ronald Regal *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 297-301 Sponsored in part by EPA, Washington, D.C. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13934# International Mathematical and Statistical Library, Houston, Tex.
A JOHNSON CURVE APPROACH TO WARMING UP TIME SERIES SIMULATIONS
David A. Burn *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 302-306 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13935# International Mathematical and Statistical Library, Houston, Tex.
CENSORED DISCRETE DATA AND GENERALIZED LINEAR MODELS
Douglas B. Clarkson *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 307-311 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13936# RCA Labs., Princeton, N. J.
HOTELLING'S T2, ROBUST PRINCIPAL COMPONENTS AND GRAPHICS FOR SPC
David Coleman *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 312-326 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13937# Arizona State Univ., Tempe.
COLLINEARITY AND POINTS OF EXPANSION IN POLYNOMIAL REGRESSION Interim Report
Michael F. Driscoll *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 327-331 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13938# Carnegie-Mellon Univ., Pittsburgh, Pa.
A WORKSTATION-BASED ENVIRONMENT FOR STATISTICAL ANALYSIS OF SET-VALUED DATA
Lionel Galway *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 332-334 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13941# Massachusetts Inst. of Tech., Cambridge.
SOLVING NONLINEAR ECONOMETRIC MODELS USING VECTOR PROCESSORS
Patrick J. Henaff and Alfred L. Norman (Texas Univ., Austin.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 348-351 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13947# Pennsylvania State Univ., University Park.
A GENERAL TECHNIQUE FOR GENERATING PSEUDO MULTIVARIATE RANDOM VARIABLES: A MARKOV PROCESS APPROACH
Subhash R. Lele and M. T. Boswell *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 377-380 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13948# Zagreb Univ. (Yugoslavia).
INFERENCE IN ROBUST DISCRIMINANT ANALYSIS
Vesna Luzar *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 381-385 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13951# Forest Service, Berkeley, Calif.
FITTING PARAMETRIC AND SEMI-PARAMETRIC PROBIT FORMS WITH NON-ZERO BACKGROUND
Haiganoush K. Preisler *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 396-401 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13952# Numerical Algorithms Group Ltd., Oxford (England).
ON THE FITTING AND FORECASTING OF VECTOR TIME SERIES MODELS
B. L. Shea *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 402-404 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13953# University of Southern Illinois, Edwardsville.
PREDICTION INTERVALS FOR THE GAMMA DISTRIBUTION
Wei-Kei Shiue and Lee J. Bain (Missouri Univ., Rolla.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 405-410 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13954# Department of Agriculture, Washington, D.C.
COMPUTER-AIDED SURVEY METHODS
Robert D. Tortora, Frederic A. Vogel, and J. Merrill Shanks (California Univ., Berkeley.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 411-413 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13956# Michigan Univ., Flint.
SOLUTION OF LEAST SQUARES EQUATIONS BY INCOMPLETE QR FACTORIZATION
J. W. Trigg and A. K. Rigler (Missouri Univ., Rolla.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 420-423 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13957# Baylor Univ., Waco, Tex.
POLYHEDRON GRAPHS
Danny W. Turner, John W. Seaman, and Dean M. Young *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 424-425 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13958# Fordham Univ., New York, N.Y.
EFFICIENT ESTIMATION AND TESTING FOR HETEROSCEDASTICITY WITHOUT AUXILIARY VARIABLES
H. D. Vinod and Aman Ullah (University of Western Ontario, London.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 426-431 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13959# General Motors Corp., Warren, Mich.
THE SELECTION OF A STATISTICAL DATA ANALYSIS COMPUTING ENVIRONMENT FOR AN INDUSTRIAL RESEARCH LABORATORY
James G. Wendelberger and Michael A. Wincek *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 432-437 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13960# Tuebingen Univ. (West Germany).
AN EXPERT SYSTEM FOR TESTING STATISTICAL HYPOTHESES
Knut M. Wittkowski *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 438-443 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13961# Arizona State Univ., Tempe.
AN EVALUATION OF TIME SERIES ANALYSIS PROGRAMS AVAILABLE IN THREE MAJOR STATISTICAL COMPUTER PACKAGES
Terry J. Woodfield *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 444-449 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13962# Wisconsin Univ., Madison.
ALGORITHMS FOR NONLINEAR GENERALIZED CROSS-VALIDATION
Brian S. Yandell *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 450-455 (For primary document see N89-13901 05-60)
(Grants CSRS-511-100; NSF DMS-84-04970)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-14170*# Missouri Univ., Rolla. Dept. of Computer Science.
PERFORMANCE EVALUATION OF NASA/KSC CAD/CAE GRAPHICS LOCAL AREA NETWORK
George Zobrist *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 520-557 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N89-13997# Stanford Univ., Calif. Dept. of Computer Science.
DECENTRALIZED NAMING IN DISTRIBUTED COMPUTER SYSTEMS Ph.D. Thesis
Timothy P. Mann Sep. 1987 97 p
(Contracts MDA903-80-C-0102; N00039-83-K-0431)
(AD-A198671; SU-STAN-CS-87-1179) Avail: NTIS HC A05/MF A01 CSCL 12G

Designing a global character-string naming facility is an important and difficult problem in distributed systems. Providing global names-names that have the same meaning on any participating machine-is a vital step in welding a collection of individual computers into a single, coherent system. But the nature of large distributed systems makes it difficult to implement global naming with acceptable efficiency, fault tolerance, and security: network communication is costly, system components can fail independently, and parts of the system may belong to many autonomous and mutually-suspicious groups. Existing name service designs do not solve the problem in full; even the best current designs do not have the efficiency or capacity to name every object in a large system-they generally name only hosts or mailboxes, not files. This thesis introduces a new paradigm for name service called decentralized naming. Directories at different levels of the global naming hierarchy are implemented using different techniques. The uppermost (global) levels employs conventional distributed name serves for scalability, while at lower (regional and local) levels, naming is handled directly by the managers of the named objects. The name mapping protocol uses multicast for fault tolerance and a specialized caching technique for efficiency. A capability system provides security against counterfeit replies to name lookup requests. GRA

N89-13998# Yale Univ., New Haven, Conn. Dept. of Computer Science.
AN EXPERIMENTAL STUDY OF METHODS FOR PARALLEL PRECONDITIONED KRYLOV METHODS
Doug Baxter, Joel Saltz, Martin Schultz, Stan Eisenstat, and Kay Crowley Jun. 1988 26 p
(Contract N00014-86-G-0564)
(AD-A198697; YALEU/DCS/RR-629) Avail: NTIS HC A03/MF A01 CSCL 12E

High performance multiprocessor architectures differ both in the number of processors, and in the delay costs for synchronization and communication. In order to obtain good performance on a given architecture for a given problem, adequate parallelization, good balance of load and an appropriate choice of granularity are essential. This document discusses the implementation of parallel version of PCGPAK for both shared memory architectures and hypercubes. The authors' parallel implementation is sufficiently efficient to allow them to complete the solution of our test problems on 16 processors of the Encore Multimax/320 in an amount of time that is a small multiple of that required by a single head of a Cray X/MP, despite the fact that the peak performance of the Multimax processors is not even close of the supercomputer range. The authors illustrate the effectiveness of our approach on a number of model problems from reservoir engineering and mathematics. GRA

N89-13999*# Stanford Univ., Calif. Dept. of Computer Science.
EXPERIMENTS WITH A KNOWLEDGE-BASED SYSTEM ON A MULTIPROCESSOR
Russell Nakano and Masafumi Minami Oct. 1987 51 p
Sponsored in part by Boeing Corp., Seattle; and Digital Equipment Corp.

(Contracts NCC2-220; F30602-85-C-0012)
(NASA-CR-183379; NAS 1.26:183379; AD-A198708; SU-STAN-CS-87-1188) Avail: NTIS HC A04/MF A01 CSCL 09B

The results obtained and the lessons learned in the design, implementation, and execution of a simulated real-time application on a simulated parallel processor are discussed. Specifically, the parallel program ran 100 times faster on a 100-processor multiprocessor compared to a 1-processor multiprocessor. The machine architecture is a distributed-memory multiprocessor. The target machine consists of 10 to 1000 processors, but because of simulator limitations, simulations of machines were run consisting of 1 to 100 processors. Each processor is a computer with its own local memory, executing an independent instruction stream. There is no global shared memory; all processes communicate by message passing. The target programming environment, called Lamina, encourages a programming style that stresses performance gains through problem decomposition, allowing many processors to be brought to bear on a problem. The key is to distribute the processing load over replicated objects, and to increase throughput by building pipelined sequences of objects that handle stages of probel solving. The focus is on a knowledge-base application that simulates real-time understanding of radar tracks, called Airtrac. This paper describes a portion of the Airtrac application implemented in Lamina and a set of experiments performed. GRA

N89-14000# Maryland Univ., College Park. Systems Design and Analysis Group.
ALLOCATION OF REAL-TIME COMPUTATIONS UNDER FAULT TOLERANCE CONSTRAINTS
Shem-Tov Levi, Daniel Mosse, and Askok K. Agrawala 3 May 1988 46 p
(Contracts N00014-87-K-0241; DASG60-87-C-0066)
(AD-A198863; UMIACS-TR-88-32; CS-TR-2018) Avail: NTIS HC A03/MF A01 CSCL 12E

Allocation of resources in next generation real time operating systems requires some important features in addition to those demonstrated by current systems, resulting in an increased complexity of each system. The allocation is closely related to the scheduling, and the two are based on time considerations, rather then on a static priority scheme. The allocation is fault tolerance motivated, to cope with the application's reliability goals. Distributed system issues and adaptive behavior requirements increase the complexity and significance of the allocation approach. The allocation scheme proposed here accomplishes the hard real time goal of guaranteeing a deadline satisfaction in case the job is accepted. In addition, this allocation scheme supports fault tolerance objectives in both damage containment and resiliency requirements. It does this in cooperation with a schedulability verification mechanism, and with an object architecture in which for each object there exists a calendar that maintains the time of its execution. A nice feature of this scheme is the way in which it can be used for reallocation while increasing the resiliency. GRA

N89-14001# Oak Ridge National Lab., Tenn. Intelligent Systems Group.
RULE-BASED APPROACH TO TELECOMMUNICATIONS DESIGN
W. A. Bratten, M. L. Johnson, M. L. Emrich, and J. M. Williams 29 Apr. 1988 12 p Presented at the 3rd International Symposium on Methodologies for Intelligent Systems, Charlotte, N.C., 12 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE88-012204; CONF-881090-1) Avail: NTIS HC A03/MF A01

A continued rise in interconnectivity requirements and shortage of experienced systems integrators characterizes a growing need for access to data networking information. An expert system is under development to capture telecommunications design knowledge. The system contains information regarding the design of both Wide Area Networks (WAN) and Local Area Networks (LAN). The system is modular in design and can be tailored to specific organizations. This paper presents the features of the LAN module. DOE

N89-14002*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HARDWARE PROOFS USING EHDM AND THE RSRE VERIFICATION METHODOLOGY
Ricky W. Butler and Jon A. Sjogren Dec. 1988 90 p
(DA Proj. 1L1-61102-AH-45-E)
(NASA-TM-100669; NAS 1.15:100669; AVSCOM-TM-88-B-017)
Avail: NTIS HC A05/MF A01 CSCL 09B

Examined is a methodology for hardware verification developed by Royal Signals and Radar Establishment (RSRE) in the context of the SRI International's Enhanced Hierarchical Design Methodology (EHDM) specification/verification system. The methodology utilizes a four-level specification hierarchy with the following levels: functional level, finite automata model, block model, and circuit level. The properties of a level are proved as theorems in the level below it. This methodology is applied to a 6-bit counter problem and is critically examined. The specifications are written in EHDM's specification language, Extended Special, and the proofs are improving both the RSRE methodology and the EHDM system. Author

N89-14003*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
STUDY OF A UNIFIED HARDWARE AND SOFTWARE FAULT-TOLERANT ARCHITECTURE Final Report
Jaynarayan Lala, Linda Alger, Steven Friend, Gregory Greeley, Stephen Sacco, and Stuart Adams Jan. 1989 67 p
(Contract NAS1-18061)
(NASA-CR-181759; NAS 1.26:181759) Avail: NTIS HC A04/MF A01 CSCL 09B

A unified architectural concept, called the Fault Tolerant Processor Attached Processor (FTP-AP), that can tolerate hardware as well as software faults is proposed for applications requiring ultrareliable computation capability. An emulation of the FTP-AP architecture, consisting of a breadboard Motorola 68010-based quadruply redundant Fault Tolerant Processor, four VAX 750s as attached processors, and four versions of a transport aircraft yaw damper control law, is used as a testbed in the AIRLAB to examine a number of critical issues. Solutions of several basic problems associated with N-Version software are proposed and implemented on the testbed. This includes a confidence voter to resolve coincident errors in N-Version software. A reliability model of N-Version software that is based upon the recent understanding of software failure mechanisms is also developed. The basic FTP-AP architectural concept appears suitable for hosting N-Version application software while at the same time tolerating hardware failures. Architectural enhancements for greater efficiency, software reliability modeling, and N-Version issues that merit further research are identified. Author

N89-13904# Carnegie-Mellon Univ., Pittsburgh, Pa.
PARALLEL ARCHITECTURE: A TUTORIAL FOR STATISTICIANS
William F. Eddy *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 23-29 (For primary document see N89-13901 05-60)
(Contracts N00014-84-G-0137; N00014-84-K-0588; NSF MCS-82-05126; NSF DMS-84-04927)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13905# Carnegie-Mellon Univ., Pittsburgh, Pa.
DISCRETE-FINITE INFERENCE ON A NETWORK OF VAXes
William F. Eddy and Mark J. Schervish *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 30-36 (For primary document see N89-13901 05-60)
(Contracts N00014-84-G-0137; N00014-84-K-0588; NSF MCS-82-05126; NSF DMS-84-04927)
Avail: NTIS HC A20/MF A01 CSCL 12F

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N89-14004*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION TESTS OF THE OPTIMIZATION METHOD OF HOPFIELD AND TANK USING NEURAL NETWORKS
Russell A. Paielli Nov. 1988 15 p
(NASA-TM-101047; A-88275; NAS 1.15:101047) Avail: NTIS HC A03/MF A01 CSCL 09B

The method proposed by Hopfield and Tank for using the Hopfield neural network with continuous valued neurons to solve the traveling salesman problem is tested by simulation. Several researchers have apparently been unable to successfully repeat the numerical simulation documented by Hopfield and Tank. However, as suggested to the author by Adams, it appears that the reason for those difficulties is that a key parameter value is reported erroneously (by four orders of magnitude) in the original paper. When a reasonable value is used for that parameter, the network performs generally as claimed. Additionally, a new method of using feedback to control the input bias currents to the amplifiers is proposed and successfully tested. This eliminates the need to set the input currents by trial and error. Author

N89-14005# Oak Ridge National Lab., Tenn. Center for Engineering Systems Advanced Research.
ONGOING RESEARCH USING HERMIES: THE HOSTILE ENVIRONMENT ROBOTIC MACHINE INTELLIGENCE EXPERIMENT SERIES
B. L. Burks and P. F. Spelt 1988 27 p Presented at the Materials Handling FOCUS '88, Atlanta, Ga., 13 Sep. 1988
(Contract DE-AC05-84OR-21400)
(DE88-016352; CONF-8809122-1) Avail: NTIS HC A03/MF A01

In order to test and validate the hardware and software developed in the research activities of CESAR (Center of Engineering Systems Advanced Research) a series of mobile autonomous robotic vehicles are being assembled named HERMIES (Hostile Environment Robotic Machine Intelligence Experiment Series). The current experimental test bed HERMIES-IIB, is the third in the series. A description of the earlier HERMIES robots and research activities may be found in the literature. HERMIES-IIB has been operational for more than a year and is described in detail in this article and elsewhere. In addition to a description of the robot, this article details some of the experiments under way utilizing HERMIES-IIB. The fourth robot in the series, HERMIES-III, is currently being assembled and should be available for experiments during the fall of 1988. This robot and initial experiments planned for it are also briefly described in this paper. DOE

N89-14006*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DYNAMIC EVALUATION OF A TRACTION-DRIVE JOINT FOR SPACE TELEROBOTS
Clarence W. deSilva (British Columbia Univ., Vancouver.) and Walter W. Hankins, III Oct. 1988 31 p
(NASA-TM-101499; NAS 1.15:101499) Avail: NTIS HC A03/MF A01 CSCL 09B

Presented is an analysis and evaluation of a prototype traction-drive joint for robotic manipulators, developed under NASA sponsorship. A dynamic model is developed using the Lagrange formulation. Controllability, observability, dynamic stability, and response characteristics of the joint to test inputs are studied. A linear quadratic regulator (LQR) is implemented on the joint model to determine a basis for evaluating the performance of the traction-drive joint under servo control. An evaluation of the results and directions for future investigations are presented. Author

N89-14007# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering and Computer Science.
FAULT TOLERANT PARALLEL IMPLEMENTATIONS OF ITERATIVE ALGORITHMS FOR OPTIMAL CONTROL PROBLEMS Annual Report, 1 Jan. - 31 Dec. 1987
Gerard G. Meyer and Howard L. Weinert 21 Jan. 1988 9 p
(Grant AF-AFOSR-0097-85; AF Proj. 2304)
(AD-A198041; AFOSR-88-0782TR) Avail: NTIS HC A02/MF A01 CSCL 12G

This annual report briefly describes progress on research in algorithms for optimal control problems. The principal research focus has been on a new approach to the parallel implementation of iterative algorithms for optimal control based on a two level parametrization of optimally conditions, and a secondary research focus has been the investigation of fault detection in the type of computational networks used for optimal control computations. Publications describing the results in detail are listed. GRA

N89-13915# Harvard Univ., Cambridge, Mass.
ARTIFICIAL INTELLIGENCE TECHNIQUES FOR RETROSPECTIVE HELP IN DATA ANALYSIS
William H. Nugent *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 118-121 Sponsored in part by ONR, Washington, D.C. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N89-14008# National Center for Earthquake Engineering Research, Buffalo, N.Y.
STOCHASTIC FINITE ELEMENT EXPANSION FOR RANDOM MEDIA
P. D. Spanos and R. Ghanem (Rice Univ., Houston, Tex.) 14 Mar. 1988 43 p
(Grant NSF ECE-86-07591)
(PB88-213806; NCEER-88-0005) Avail: NTIS HC A03/MF A01 CSCL 12A

A new method for the solution of problems involving random media is proposed. The medium property is represented by a stochastic process. The method makes use of an orthogonal expansion of the process with a finite set of random variables and leads to a formulation compatible with the finite element method. The usefullness of the method, in terms of accuracy and efficiency, is exemplified by considering a cantilever beam with random rigidity. GRA

N89-14009# National Academy of Sciences - National Research Council, Washington, D. C. Board on Mathematical Sciences.
REPORT OF THE ADVISORY PANEL TO THE MATHEMATICAL AND INFORMATION SCIENCE DIRECTORATE, AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
Wendell Fleming 1 Apr. 1988 46 p
(Contract F49620-86-C-0023)
(AD-A196095; AFOSR-88-0601TR) Avail: NTIS HC A03/MF A01 CSCL 12B

The Advisory Panel was charged specifically with appraising the balance and general effectiveness of the programs of the Mathematical and Information Sciences Directorate and preparing recommendations and suggestions in response to questions such as the following: (1) Do research plans address critical technical issues within the scope of the mission of the Directorate; (2) Is the planning adequate for the near term and for the long term; (3) Is the work appropriate and effective in reaching the objectives of the program; and (4) Is the research work itself at the state of the art and what is the quality of the investigators being supported. This report discusses the following topics: Impact of the

Directorate's Research on Air Force Technology Needs; Proposal Review and Selection Procedures; Opportunities If More Funds Were Available; Dynamics and Control; Communications and Signal Processing; Optimization; Probability and Statistics; Computational Mathematics; Finite Mathematics; Computer Science; Artificial Intelligence; Physical Mathematics and Applied Analysis Overview; Relations with Air Force Labs; Recommendations Concerning the Future. Author

N89-14010# International Centre for Theoretical Physics, Trieste (Italy).
NON-RESONANT OSCILLATIONS FOR SOME THIRD-ORDER DIFFERENTIAL EQUATIONS 2
J. O. C. Ezeilo and P. Omari Nov. 1987 25 p
(DE88-702994; IC-87/374) Avail: NTIS (US Sales Only) HC A03/MF A01

The existence of 2-periodic solutions to the equation $x''' + ax'' + g(t,x') + cx = p(t)$ is proved, under certain non-resonance conditions on the non-linear function g(t,y). Here a,c are constants, but the case where a,c are not necessarily constants is also discussed, subject to some rather special non-resonance conditions on g. The uniqueness of the solutions is also examined. DOE

N89-14011# Stanford Univ., Calif. Dept. of Operations Research.
SIMULATION METHODS FOR QUEUES: AN OVERVIEW Technical Report No. 28
Peter W. Glynn and Donald L. Iglehart Apr. 1988 41 p
(Grants NSF DCR-85-09668; NSF ECS-84-04809)
(AD-A197084; TR-28; ARO-20927.25-MA) Avail: NTIS HC A03/MF A01 CSCL 12D

This paper gives an overview of those aspects of simulation methodology that are (to some extent) peculiar to the simulation of queueing systems. A generalized semi-Markov process framework for describing queueing systems is used through much of the paper. The main topics covered are: output analysis for simulation of transient and steady-state quantities, variance reduction methods that exploit queueing structure, and gradient estimation methods for performance parameters associated with queueing networks. GRA

N89-14012# Stanford Univ., Calif. Dept. of Operations Research.
LIKELIHOOD RATIO GRADIENT ESTIMATION: AN OVERVIEW Technical Report No. 27
Peter W. Glynn Oct. 1987 12 p
(Contract DAAG29-84-K-0030; NSF DCR-85-09668)
(AD-A197065; ARO-20927.24-MA) Avail: NTIS HC A03/MF A01 CSCL 12D

The likelihood ratio method for gradient estimation is briefly surveyed. Two applications settings are described, namely Monte Carlo optimization and statistical analysis of complex stochastic systems. Steady-state gradient estimation is emphasized, and both regenerative and non-regenerative approaches are given. The paper also indicates how these methods apply to general discrete-event simulations; the idea is to view such systems as general state space Markov chains. This document considers a single-server queue in which the service rate theta is a decision variable. Given that alpha(theta) is the steady-state cost of running the queue at parameter level theta, one is frequently interested in minimizing alpha (theta) over a suitable constraint set. Since alpha is often difficult to evaluate analytically, Monte Carlo optimization is an attractive methodology. By analogy with deterministic mathematical programming, efficient Monte Carlo gradient estimation is typically an important ingredient of simulation based optimization algorithms. As a consequence, gradient estimation has recently attracted considerable attention in the simulation community. It is the author's goal, in this paper, to describe one such method for estimating gradients in the Monte Carlo setting, namely the likelihood ratio method. GRA

N89-14013# North Carolina Univ., Chapel Hill. Psychometric Lab.
DIRECT AND INDIRECT SCALING OF MEMBERSHIP FUNCTIONS OF PROBABILITY PHRASES Interim Report, Oct. 1984 - Oct. 1985
Amnon Rapoport, Thomas S. Wallsten, and James A. Cox Jun. 1988 57 p
(Contract MDA903-83-K-0347; DA Proj. 2Q1-61102-B-74-F)
(AD-A197436; TR-174; ARI-RN-88-43) Avail: NTIS HC A04/MF A01 CSCL 12D

A crucial issue in the empirical measurement of membership functions is whether the degree of fuzziness is invariant under different scaling procedures. In this paper a direct and an indirect procedure, magnitude estimation and graded pair-comparison, are compared in the context of establishing membership functions for probability phrases such as probable, rather likely, very unlikely, and so forth. Analyses at the level of individual respondents indicate that: (1) membership functions are stable over time, (2) functions for each phrase differ substantially over people, (3) the two procedures yield similarly shaped functions for a given person-phrase combination, (4) the functions from the two procedures differ systematically, in that those obtained directly dominate, or indicate greater fuzziness than do those obtained indirectly, and (5) where the two differ the indirectly obtained function may be the more accurate one. A secondary purpose of the paper is to evaluate the effects of the modifiers very and rather. Very has a general intensifying effect that is described by Zadeh's (1972) concentration model for seven subjects and by a shift model for no one. The effects of rather are unsystematic and not described by an available model. GRA

N89-14014*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
DESIGN OF BLENDED ROLLED EDGES FOR COMPACT RANGE MAIN REFLECTORS
K. P. Ericksen, I. J. Gupta, and W. D. Burnside Aug. 1988 104 p
(Grant NsG-1613)
(NASA-CR-183375; NAS 1.26:183375; TR-716148-33) Avail: NTIS HC A06/MF A01 CSCL 12A

A procedure to design blended rolled edge terminations for arbitrary rim shape compact range main reflectors is presented. The reflector may be center-fed or offset-fed. The design procedure leads to a reflector which has a continuous and smooth surface. This procedure also ensures small diffracted fields from the junction between the paraboloid and the blended rolled edge while satisfying certain constraints regarding the maximum height of the reflector and minimum operating frequency of the system. The prescribed procedure is used to design several reflectors and the performance of these reflectors is presented. Author

N89-14015# Yale Univ., New Haven, Conn. Dept. of Computer Science.
RECURSIVE MESH REFINEMENT ON HYPERCUBES
W. D. Gropp and Ilse C. Ipsen Mar. 1988 23 p
(Contracts N00014-85-K-0461; N00014-86-K-0310; DAAL03-86-K-0158; NSF OCR-85-21451)
(AD-A198695; YALEU/DCS/RR-616) Avail: NTIS HC A03/MF A01 CSCL 12E

Adaptive methods for partial differential equations can be viewed as a graph problem. Parallel methods must distribute this graph efficiently among the processors. In doing this, the cost of communication between processors and the structure of the graph must be considered. The author divides this problem into two phases: labeling of graph nodes and subsequent mapping of these labels onto processors. He describes a new form of Gray-code which is called an interleaved Gray-code that allows easy labeling of graph nodes even when the maximal level of refinement is unknown, allows easy determination of nearby nodes in the graph, is completely deterministic, and often (in a well-defined sense) distributes the graph efficiently across a hypercube. The theoretical results are supported by computational experiments on the Connection Machine. GRA

N89-14016# Maryland Univ., College Park. Inst. for Advanced Computer Studies.
SOME ASPECTS OF PARALLEL IMPLEMENTATION OF THE FINITE ELEMENT METHOD ON MESSAGE PASSING ARCHITECTURES
Ivo Babuska and H. C. Elman May 1988 31 p
(Contract N00014-85-K-0169; NSF DMS-86-07478)
(AD-A198731; UNIAC-TR-88-35; CS-TR-2030) Avail: NTIS HC A03/MF A01 CSCL 12E

Discussed are some aspects of implementing the finite element method on parallel computers with local memory and message passing. In particular, the costs of using high order and low order elements, and of direct and iterative solvers are compared for solving the linear systems that occur. Our model of parallel computation is a two-dimensional grid of processors chosen to be similar in shape to the underlying grid. Our main conclusions are that sparse direct solvers generalize naturally to methods based on high order elements, and that direct solvers are adequate for two-dimensional problems, especially for multiple load vectors. High order methods are shown to achieve higher accuracy at less cost on some typical model problems. GRA

N89-14017# George Mason Univ., Fairfax, Va. Dept. of Operations Research and Applied Statisti cs.
ROBUSTNESS OF ROOTFINDING IN QUEUEING ANALYSES
Mohan L. Chaudhry, Carl M. Harris, and William G. Marchal 31 Aug. 1988 32 p
(Contract N00014-86-K-0029)
(AD-A198916; GMU/22472/103) Avail: NTIS HC A03/MF A01 CSCL 12D

There has been frequent controversy over the years regarding the use of numerical rootfinding for the solution of queueing problems. It has been said that such problems quite often present fairly typical computational difficulties. However, it turns out that rootfinding in queueing is so well structured that problems do not occur. There are fundamental properties possessed by the well-known queueing models that eliminate classical rootfinding problems. Most importantly, we show that uniqueness of roots is standard within simply determined regions in the complex plane and prove that the G/EK/1 model has unique roots easily found inside the complex unit circle. Extensive computational results are given to support our contentions. GRA

N89-14018# Harvard Univ., Cambridge, Mass. Dept. of Statistics.
RESAMPLING METHODS FOR TIME SERIES
Ernesto Ramos 27 Aug. 1988 64 p
(Contract N00014-86-K-0246)
(AD-A198942; ONR-C-2) Avail: NTIS HC A04/MF A01 CSCL 12C

The contents of this report on resampling methods in time series analysis is as follows: Introduction; Background; Linear functionals of the spectrum; Estimating the spectral density; Simulation algorithms; Applications; Improving estimators by resampling. GRA

N89-14019# Air Force Academy, Colo. Dept. of Mathematical Sciences.
PLANE SYMMETRY GROUPS Final Report, Aug. 1987 - Jun. 1988
David W. Jensen and Robert G. Harvey Jun. 1988 56 p
(AD-A198952; USAFA-TR-88-4) Avail: NTIS HC A04/MF A01 CSCL 12B

This paper presents the basic mathematical theory behind plane symmetry groups. This theory is then applied in classifying the symmetry of bounded figures, frieze patterns and wall paper patterns. Recently developed algorithms are included to help analyze complex designs. Over 100 examples are presented in the next to clarify concepts and to illustrate the various symmetry types. GRA

N89-14020# Naval Ocean Systems Center, San Diego, Calif.
SMOOTHED REGRESSION ESTIMATES WITH PEARSON NOISE Final Technical Report, 1987 - 1988
Roger W. Johnson Jul. 1988 57 p
(AD-A198973; NOSC/TR-1231) Avail: NTIS HC A04/MF A01 CSCL 12C

Li and Hwang (1984) examined estimates for a regression problem which are a compromise between the naive, raw data estimate and a nonparametric estimate. They developed such compromise, or smoothed, estimates assuming Gaussian noise. This report, develops method regression estimates in the more general case in which Pearson noise is present. Estimates are established having good Bayes risk and ordinary risk. GRA

N89-14021# Lawrence Livermore National Lab., Calif.
A FINITE ELEMENT TECHNIQUE FOR SOLVING THE TWO-DIMENSIONAL MAXWELL'S EQUATIONS IN THE TIME DOMAIN
Robert L. Lee and Neil K. Madsen Feb. 1988 8 p Presented at the 1st International Conference on Computational Methods in Flow Analysis, Okayama, Japan, 5 Sep. 1988
(Contract W-7405-eng-48)
(DE88-013818; UCRL-97390; CONF-880936-3) Avail: NTIS HC A02/MF A01

A two-dimensional Galerkin finite element formulation of the Maxwell's equations in the time domain is presented. The Galerkin element integrals are computed analytically and an explicit forward-backward time integration scheme is employed for advancing the resulting set of ordinary differential equations in time. We will compare two formulations of the simple 4-node bilinear element: an equal-order interpolation element in which both the electric field and the magnetic field are approximated by bilinear basis functions; and a mixed-interpolation element in which the electric field is approximated as piecewise constant and the magnetic field as piecewise bilinear functions. The mixed formulation may be viewed as a finite element analog to certain staggered finite difference representations. Numerical examples will be presented to evaluate the accuracy of these two elements. DOE

N89-14022# Los Alamos National Lab., N. Mex. Center for Nonlinear Studies.
HAMILTONIAN REDUCTION AND COMPLEX BEHAVIOUR IN NONLINEAR POLARIZATION DYNAMICS
D. David 1988 5 p Presented at the 17th International Colloquium on Group Theoretical Methods in Physics, Montreal, Quebec, 27 Jun. 1988
(Contract W-7405-eng-36)
(DE88-016332; LA-UR-88-2652; CONF-8806105-1) Avail: NTIS HC A02/MF A01

The problem of two counterpropagating optical beams in a nonlinear medium is investigated as an Hamiltonian system. The phase space is an eight-dimensional manifold isomorphic to C squared x C squared. Invariance of the system under the action of several copies of the O(1) group allows for its reduction to the two-sphere onto which the resulting induced Hamiltonian system is therefore completely integrable. We determine all the fixed points of the system, corresponding to physical static solutions, and examine the bifurcations that occur as parameters are varied. Orbits connecting hyperbolic fixed points are special and determine physical soliton-like and kink-like solutions. We also look at how chaos, in particular Horseshoe chaos and Arnold diffusion, arises when the system is subject to certain types of perturbations. DOE

N89-14023# Los Alamos National Lab., N. Mex. Computer Research and Applications.
A LOOK AT TRANSPORT THEORY FROM THE POINT OF VIEW OF LINEAR ALGEBRA
V. Faber and Thomas A. Manteuffel 1988 26 p Presented at the Conference on Transport Theory, Invariant Imbedding and Integral Equations, Santa Fe, N. Mex., 20 Jan. 1988

(Contract W-7405-eng-36)
(DE88-016337; LA-UR-88-2625; CONF-880123-5) Avail: NTIS HC A03/MF A01

We show that the notion of preconditioning from linear algebra can provide a framework for the discussion of algorithms for the numerical solution of the transport equation. In this context we show that the conjugate gradient method yields substantial savings over the Neumann series solution of the standard integral formulation of the transport equation for optically thick regimes. Further, we show that the diffusion synthetic acceleration (DSA) algorithm is the Neumann series solution of the standard integral formulation of the transport equation preconditioning by the Green's function of a diffusion operator. The preconditioned conjugate gradient method, using DSA as a preconditioner, again yields substantial savings. DOE

N89-14024# Argonne National Lab., Ill. Mathematics and Computer Science Div.
THE SOLUTION OF A PARABOLIC PARTIAL DIFFERENTIAL EQUATION VIA DOMAIN DECOMPOSITION: THE SYNTHESIS OF ASYMPTOTIC AND NUMERICAL ANALYSIS
Jeffrey S. Scroggs Jun. 1988 145 p
(Contracts W-31-109-eng-38; W-7405-ENG-48; DE-FG02-85ER-25001; AF-AFOSR-0211-85)
(DE88-016889; ANL/MCS-TM-123) Avail: NTIS HC A08/MF A01

A parallel algorithm for the efficient solution of a time dependent reaction convection diffusion equation with small parameter on the diffusion term will be presented. The method is based on a domain decomposition that is dictated by singular perturbation analysis. The analysis is used to determine regions where certain reduced equations may be solved in place of the full equation. Parallelism is evident at two levels. Domain decomposition provides parallelism at the highest level, and within each domain there is ample opportunity to exploit parallelism. Run-time results demonstrate the viability of the method. DOE

N89-14025# International Centre for Theoretical Physics, Trieste (Italy).
BESSEL POLYNOMIALS AND THEIR DIFFERENTIAL OPERATORS
V. P. Onyango-Otieno Oct. 1987 14 p Submitted for publication
(DE88-703514; IC-87/345) Avail: NTIS (US Sales Only) HC A03/MF A01

Differential operators associated with the ordinary and the generalized Bessel polynomials are defined. In each case the commutator bracket is constructed and shows that the differential operators associated with the Bessel polynomials and their generalized form are not commutative. Some applications of these operators to linear differential equations are also discussed. DOE

N89-14026# International Centre for Theoretical Physics, Trieste (Italy).
DIFFERENTIAL OPERATORS ASSOCIATED WITH GEGENBAUER POLYNOMIALS. 1: THE LIMIT-CIRCLE CASE
V. P. Onyango-Otieno Oct. 1987 24 p Submitted for publication
(DE88-703515; IC-87/346-Pt-1) Avail: NTIS (US Sales Only) HC A03/MF A01

We study the right-definite limit-circle case (1/2 less than or equal to upsilon (3/2) of the Gegenbauer differential equation -((1-x sup 2) sup upsilon+1 2 y')'+upsilon sup 2 (1-x sup 2) sup upsilon-1 2 y(x) =lambda(1-x sup 2) sup upsilon-1 2 y(x), (x epsilon (-1,1), lambda epsilon C), following Titchmarsh's classical approach. We link the Titchmarsh method with operator theoretic results in the space L sup 2 sub w (-1,1). DOE

N89-14027# International Centre for Theoretical Physics, Trieste (Italy).
DIFFERENTIAL OPERATORS ASSOCIATED WITH GEGENBAUER POLYNOMIALS. 2: THE LIMIT-POINT CASE
V. P. Onyango-Otieno Oct. 1987 19 p Submitted for publication
(DE88-703516; IC-87/347-Pt-2) Avail: NTIS (US Sales Only) HC A03/MF A01

In this paper we study the limit-point case of the Gegenbauer differential equation -((1-x sup 2) sup upsilon+1 2 y'(x)) sup 1 +upsilon sup 2(1-x sup 2) sup upsilon-1/2 y(x)=lambda(1-x sup 2) sup upsilon-1/2 y(x), (x epsilon (-1,1), lambda epsilon C) in both the so-called right-definite and left-definite cases based partially on a classical approach due to E.C. Titchmarsh. We then link the Titchmarsh approach with operator theoretic results in the spaces L sup 2 sub w (-1,1) and H sup 2 sub p,q (-1,1). DOE

N89-14028# International Centre for Theoretical Physics, Trieste (Italy).
REMARKABLE ALGEBRA so*(2n), ITS REPRESENTATIONS, ITS CLIFFORD ALGEBRA AND POTENTIAL APPLICATIONS
A. O. Barut and A. J. Bracken Jan. 1988 30 p Submitted for publication
(DE88-703836; IC-88/26) Avail: NTIS (US Sales Only) HC A03/MF A01

Properties of the real Lie algebra so*(2n) and its finite-dimensional representations are described. The structure of the Clifford algebras associated with the two fundamental spinor representations are determined, and it is found in particular that for so*(4n), there is a remarkable asymmetry: one representation is real, the other complex (though equivalent to its complex conjugate), and the associated algebras are inequivalent. Generalized Dirac matrices are defined, acting within the direct sum of these two spinor representations of so*(2n). These matrices generate a different Clifford algebra, not determined uniquely by those representations, and their commutators do not span a representation of so*(2n). The isomorphisms of so*(6) with su(3,1), and of so*(8) with so(6,2) are described, together with the corresponding mappings between finite-dimensional irreducible representations. The latter isomorphism is related to the triality property of so(8), and in particular maps the real fundamental spinor representation, the complex fundamental spinor representation, and the complex vector (defining) representation of so*(8), each of dimension eight, into the real vector representation and the two complex fundamental spinor representations of so(6,2). More generally, some tensor representations of so*(8) are mapped into spinor, others into tensor representations of so(6,2) and the same is true of spinor representations of so*(8). This raises the possibility of interesting applications of so*(2n), n greater than 4, as a generalized space-time symmetry or dynamical algebra, with tensor and spinor representations of so(3,1) less than so*(2n) contained in an irreducible multiplet. Mention is made in particular of a recent proposal by Ward to base a unified field theory on so*(14) less than so(3,1)+su(3)+su(2)+u(1). DOE

N89-14029# International Centre for Theoretical Physics, Trieste (Italy).
FINITE ELEMENTS FOR PARTIAL DIFFERENTIAL EQUATIONS: AN INTRODUCTORY SURVEY
Sauro Succi Mar. 1988 26 p Presented at the 2nd School on Advanced Techniques in Computational Physics, Trieste, Italy, 18 Jan. - 12 Feb. 1988
(DE88-703845; IC-88/63) Avail: NTIS (US Sales Only) HC A03/MF A01

After presentation of the basic ideas behind the theory of the Finite Element Method, the application of the method to three equations of particular interest in Physics and Engineering is discussed in some detail, namely, a one-dimensional Sturm-Liouville problem, a two-dimensional linear Fokker-Planck equation and a two-dimensional nonlinear Navier-Stokes equation. DOE

N89-14030# International Centre for Theoretical Physics, Trieste (Italy).
CLASS OF STRONGLY DEGENERATE ELLIPTIC OPERATORS
Duong Minh Duc Apr. 1988 26 p Submitted for publication

(DE88-703851; IC-88/76) Avail: NTIS (US Sales Only) HC A03/MF A01

Using a weighted Poincare inequality, we study (sub 1,..., sub n)-elliptic operators. This method is applicable to solve singular elliptic equations with conditions in W/sup 1,2/ on the boundary. We also get a result about the regularity of solutions of singular elliptic equations. An application to (sub 1,...sub n) -parabolic equations is given. DOE

N89-14031# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

PERTURBATION THEORY WITH THE MATRIX CONTINUED FRACTIONS

M. Znojil 1987 9 p

(DE88-703696; JINR-E-5-87-634) Avail: NTIS (US Sales Only) HC A02/MF A01

An idea of using the nondiagonal unperturbed Hamiltonians is further developed. We admit a band-matrix structure of H sub 0 and describe how the propagator R may be constructed in terms of the matrix continued fractions. The new perturbation is then described in more detail. Its numerical test employs the standard anharmonic oscillator example and shows a good applicability of the formalism, presumably to all the systems with a strong coupling between the neighboring unperturbed orbitals. DOE

N89-14032# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.

NEW METHOD TO SOLVE THE ONE-DIMENSIONAL SCHROEDINGER EQUATION

V. K. Ignatovich 1987 4 p In RUSSIAN

(DE88-703747; JINR-R-4-87-878) Avail: NTIS (US Sales Only) HC A02/MF A01

The potential in the Schroedinger equation is divided by infinitesimal narrow gaps on separate potential barriers. The tops of these barriers are approximated by the second-order polynomials. The inside wave function and reflection and transmission amplitudes are obtained for every barrier separately. After that the recurrent relations are used to present the reflection amplitude for the total potential in the chain fraction form in terms of partial barrier amplitudes. The transmission amplitude and the wave function at any point inside the potential are constructed in the same way. DOE

N89-14033# North Carolina Univ., Chapel Hill. Dept. of Statistics.

ON FUNCTIONAL ESTIMATES FOR ILL-POSED LINEAR PROBLEMS Technical Report, for Sep. 1987 - Aug. 1988

R. Brigola and A. Keller Apr. 1988 14 p

(Contract F49620-85-C-0144)

(AD-A198004; TR-229; AFOSR-88-0786TR) Avail: NTIS HC A03/MF A01 CSCL 12B

Ill-posed linear problems in Hilbert space are considered as stochastic filtering problems. Functional estimates of the signal x are given for the problem Ax-y=z where A is a linear, not necessarily bounded operator between Hilbert spaces and x, y, z are Hilbert space valued random elements. As an application, functional estimates are given explicitly for J. Radon's transformed signals with additive white noise. GRA

N89-14034# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

PARALLEL SYMMETRY-BREAKING IN SPARSE GRAPHS

Andrew V. Goldberg, Serge A. Plotkin, and Gregory E. Shannon (Purdue Univ., West Lafayette, Ind.) May 1988 26 p

(Contracts N00014-80-C-0622; N00014-86-K-0689; NSF DCR 83-20124)

(AD-A198233; MIT/LCS/TM-356) Avail: NTIS HC A03/MF A01 CSCL 12E

This document describes efficient deterministic techniques for breaking symmetry in parallel. These techniques work well on rooted trees and graphs of constant degree or genus. The authors' primary technique allows us to 3-color a rooted tree in 0(1g*n) time on an EREW PRAM using a linear number of processors. They use these techniques to construct fast linear processor algorithms for several problems, including the problem of (delta + 1)-coloring constant-degree graphs and 5-coloring planar graphs. They also prove lower bounds for 2-coloring directed lists and for finding maximal independent sets in arbitrary graphs. GRA

N89-14035*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A SIMPLIFIED ANALYSIS OF THE MULTIGRID V-CYCLE AS A FAST ELLIPTIC SOLVER Final Report

Naomi H. Decker and Shlomo Taasan (Weizmann Inst. of Science, Rehovoth, Israel) Nov. 1988 19 p Submitted for publication

(Contracts NAS1-18107; NAS1-18605; AF-AFOSR-0127-86)

(NASA-CR-181740; ICASE-88-56; NAS 1.26:181740) Avail: NTIS HC A03/MF A01 CSCL 12A

For special model problems, Fourier analysis gives exact convergence rates for the two-grid multigrid cycle and, for more general problems, provides estimates of the two-grid convergence rates via local mode analysis. A method is presented for obtaining mutigrid convergence rate estimates for cycles involving more than two grids (using essentially the same analysis as for the two-grid cycle). For the simple cast of the V-cycle used as a fast Laplace solver on the unit square, the k-grid convergence rate bounds obtained by this method are sharper than the bounds predicted by the variational theory. Both theoretical justification and experimental evidence are presented. Author

N89-14036*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOME OBSERVATIONS ON BOUNDARY CONDITIONS FOR NUMERICAL CONSERVATION LAWS Final Report

David Kamowitz Nov. 1988 14 p Submitted for publication

(Contracts NAS1-18107; NAS1-18605)

(NASA-CR-181752; ICASE-88-67; NAS 1.26:181752) Avail: NTIS HC A03/MF A01 CSCL 12A

Four choices of outflow boundary conditions are considered for numerical conservation laws. All four methods are stable for linear problems, for which examples are presented where either a boundary layer forms or the numerical scheme, together with the boundary condition, is unstable due to the formation of a reflected shock. A simple heuristic argument is presented for determining the suitability of the boundary condition. Author

N89-14037*# Old Dominion Univ., Norfolk, Va. Dept. of Mathematics and Statistics.

ESTIMATING RESIDUAL FAULT HITTING RATES BY RECAPTURE SAMPLING Final Report, period ending 31 Dec. 1988

Larry Lee and Rajan Gupta Dec. 1988 16 p

(Grant NAG1-835)

(NASA-CR-184606; NAS 1.26:184606) Avail: NTIS HC A03/MF A01 CSCL 12A

For the recapture debugging design introduced by Nayak (1988) the problem of estimating the hitting rates of the faults remaining in the system is considered. In the context of a conditional likelihood, moment estimators are derived and are shown to be asymptotically normal and fully efficient. Fixed sample properties of the moment estimators are compared, through simulation, with those of the conditional maximum likelihood estimators. Properties of the conditional model are investigated such as the asymptotic distribution of linear functions of the fault hitting frequencies and a representation of the full data vector in terms of a sequence of independent random vectors. It is assumed that the residual hitting rates follow a log linear rate model and that the testing process is truncated when the gaps between the detection of new errors exceed a fixed amount of time. Author

N89-13942# Toronto Univ. (Ontario).

B-SPLINE ESTIMATION OF THE HAZARD FUNCTION IN PERIOD ANALYSIS

John J. Hsieh *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface

26 Aug. 1987 p 352-358 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13945# Connecticut Univ., Storrs.
CALCULATING IMPROVED BOUNDS AND APPROXIMATIONS FOR MULTIPLE COMPARISONS
James R. Kenyon *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 367-371 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13946# Villanova Univ., Pa.
MEASURES OF JOINT INFLUENCE IN REGRESSION: ORTHOGONAL DECOMPOSITION, DISTRIBUTION, AN APPLICATION TO DATA ANALYSIS
Lillian Kingsbury and Richard M. Heiberger (Temple Univ., Philadelphia, Pa.) *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 372-376 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13949# Alaska Univ., Anchorage.
EXACT CONFIDENCE BOUNDS FOR PROPORTIONS
Donald L. Marx *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 386-389 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13955# Windsor Univ. (Ontario).
TWO MRPP RANK TESTS AND THEIR SIMULATED POWERS FOR SOME ASYMMETRIC POPULATIONS
Derrick S. Tracy *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 414-419 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N89-14038# International Centre for Theoretical Physics, Trieste (Italy).
ASYMPTOTIC FUNCTIONS OF MANY VARIABLES AND SINGULAR OPERATIONS WITH SCHWARTZ DISTRIBUTIONS
Bl. P. Damyanov Nov. 1987 17 p Submitted for publication
(DE88-703004; IC-87/394) Avail: NTIS (US Sales Only) HC A03/MF A01

A theory of the asymptotic functions for the case of many variables is presented. It is shown that the class F(R sup N) of these generalized functions is closed in respect to the linear algebraic and analytic operations, multiplication as well as a set of linear and polynomial changes of the variables. The existence in F(R sup N) of analogs (consistent with the linear operations) of the Schwartz distributions with point support is proved. In terms of these analogs, some formulas for singular products and changes of variables of the Dirac delta-function and its derivatives delta sup (i)/(x), x is an element of R sup N, are given. DOE

N89-14039# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
COMBINATORIAL ALGORITHMS FOR THE GENERALIZED CIRCULATION PROBLEM
Andrew V. Goldberg, Serge A. Plotkin, and Eva Tardos May 1988 39 p
(Contracts N00014-87-K-0825; N00014-86-K-0593; AF-AFOSR-0078-86)
(AD-A197409; MIT/LCS/TM-358) Avail: NTIS HC A03/MF A01 CSCL 12D

We consider a generalization of the maximum network flow problem in which the amounts of flow entering and leaving an arc are linearly related. More precisely, if x(e) units of flow enter an arc e, x(e) gamma (e) units arrive at the other end. For instance, nodes of the graph can correspond to different currencies, with the multipliers being the exchange rates. We require conservation of flow at every node except a given source node. The goal is to maximize the amount of flow excess at the source. This problem is a special case of linear programming, and therefore can be solved in polynomial time. In this paper we present the first polynomial time combinatorial optimization algorithms for this problem. The algorithms are simple and intuitive. GRA

N89-14040# Stanford Univ., Calif. Dept. of Statistics.
CHANGE POINT PROBLEMS IN REGRESSION Technical Report No. 7
Hyune-Ju Kim Jun. 1988 87 p
(Contract N00014-87-K-0078; NSF DMS-86-02335)
(AD-A197432) Avail: NTIS HC A05/MF A01 CSCL 12C

This dissertation focuses on the problem of testing for a change in the regression model when errors are independently, normally distributed with constant, known or unknown variance. In both models, the author considers the likelihood ratio test (LRT) as the problem of the boundary crossing by the discrete stochastic process and studies problems such as approximations to significance levels, powers, and confidence regions for a change point. First of all, a modified LRT is proposed and asymptotic properties of test statistics in cases of random and fixed independent variables are discussed. In both cases, the author derives analytical approximations to significance levels. When the independent variables are random, the limiting distribution of the modified LRS is a function of a Brownian motion and approximations in Siegmund are used. For fixed independent variables, the limiting distribution involves a Gaussian process with nondifferentiable sample paths. In this case, an approximation is derived assuming the known variance and mild conditions about the empirical distribution of the independent variable, using the argument in Leadbetter, Lindgren and Rootzen, modified for discrete time by Hogan and Siegmund. In Model-1, we are also concerned with the power of the LRT and confidence regions for a change point. Numerical approximations of significance levels and powers of the LRT and the results of corresponding Monte Carlo experiments are obtained. GRA

N89-14041# Naval Research Lab., Washington, D.C. Center for Applied Research in Artificial Intelligence.
BaRT (BAYESIAN REASONING TOOL) MANUAL, PRELIMINARY VERSION 2.0 Memorandum Report, 1986 - 1987
C. L. Ramsey, L. B. Booker, and N. Hota (JAYCOR, Vienna, Va.) 22 Jun. 1988 42 p
(AD-A197829; NRL-MR-6243) Avail: NTIS HC A03/MF A01 CSCL 12E

Many real world problems are associated with uncertainty; the evidence people observe which helps them to reason about some goal event is almost always uncertain and incomplete. Still, people make judgements based on this uncertain and incomplete evidence. These uncertain evidences can be combined in various ways to find the validity or strength of a hypothesis and Bayesian probability theory is a normative theory that allows one to reason about and combine uncertainties. Pearl has devised a way to represent, reason about and combine uncertain evidences in a way that conforms to the tenets of probability theory, but avoids the disadvantages usually associated with probabilistic computations of belief. BaRT is a Bayesian Reasoning Tool which implements Pearl's ideas. It has been implemented as an AI programming environment which can perform classification problem solving, and it has been used to classify ships . In BaRT, a classification problem is represented as a network of hypotheses. The belief in each value of each hypothesis can change as new evidence lends support to (or takes support away from) certain

values of the hypothesis. Section 2 provides an overview of the theoretical background for this work. Section 3 explains how to use BaRT and provides an example. Sections 4 and 5 provide details concerning the implementation of this system. This manuals describes a preliminary version of a system which is under development. Later versions of BaRT will have greater capabilities, so any of the functions and capabilities described are subject to change. GRA

N89-14042# Stanford Univ., Calif. Dept. of Statistics.
ORDERING DISTRIBUTIONS ON THE CIRCLE WITH RESPECT TO UNIFORMITY
Fred W. Huffer 29 Jun. 1988 24 p
(Contract N00014-86-K-0156)
(AD-A198869; SU-TR-406) Avail: NTIS HC A03/MF A01 CSCL 12C

Orderings (denoted much less than) for probability distributions on the circle are introduced for which mu1 is much less than mu2 means roughly that mu1 is more uniform than mu2, or that mu2 is more clumped than mu1. Somewhat more precisely, mu1 is much less than mu2 if the random variable mu1(A sub s) is less variable than the random variable mu2(A sub s) for all s where A sub s denotes a random arc of length s distributed uniformly on the circle. Some properties of the orderings are explored and applications are presented to random coverage problems on the circle, the distribution of spacings and the analysis of directional data. GRA

N89-14043# California Univ., Santa Barbara.
MATRIX THEORY Annual Report, 1 Jul. 1985 - 30 Jun. 1988
Henryk Minc 30 Jun. 1988 14 p
(Contract N00014-85-K-0489)
(AD-A198882) Avail: NTIS HC A03/MF A01 CSCL 12B

The research conducted during the period of the contract can be divided into three areas: (1) Permanents of (0,1)-circulants; (2) Minimum permanents of doubly stochastic matrices with prescribed zero entries; (3) Nonnegative matrices. GRA

N89-14044# Department of Defence, Canberra (Australia). Central Studies Branch.
CHI-SQUARED DISTRIBUTION PARAMETER APPROXIMATION
B. K. McMillan Jul. 1988 14 p
(AD-A198927; CSB-WP-RESEARCH-11; DODA-AR-005-268)
Avail: NTIS HC A03/MF A01 CSCL 12C

A quick and effective method for determining from three frequency decibles the mean of a chi square distribution and an associated linear transform has been presented. The original purpose of the calculations was to allow creation of suitably distributed OTHR frequencies to be obtained, but the general principles used are applicable in other areas either in whole or in part. Errors have been estimated and have been shown to be greatest for small values of the mean, e.g., possibly as high as 20 percent of the mean, although in practice errors of less than 10 percent for the central 80 percent of the distribution can be expected. For most common values encountered in other modelling, errors of less than 2 percent of the mean can be expected. GRA

N89-14045# International Centre for Theoretical Physics, Trieste (Italy).
GENERALIZED SOLUTIONS OF STOCHASTIC EVOLUTION EQUATIONS
Luis G. Gorostiza and Donald A. Dawson (Carleton Univ., Ottawa, Ontario) May 1988 15 p Submitted for publication Sponsored in part by the Natural Sciences and Engineering Research Council of Canada
(Grants ICEXCNA-60119; CONACyT-140102-0203-006)
(DE88-703858; IC-88/84) Avail: NTIS (US Sales Only) HC A03/MF A01

The generalized solutions of evolution equations for Gaussian processes are discussed and a few examples are given. DOE

N89-14046# Missouri Univ., Columbia. Dept. of Statistics.
NONPARAMETRIC ESTIMATION OF A LATENT TRAIT DENSITY Technical Report No. 148, 1 Aug. 1985 - 30 Sep. 1986
Paul L. Speckman 31 Jul. 1988 30 p
(Contract N00014-85-K-0626; RR04204)
(AD-A198128) Avail: NTIS HC A03/MF A01 CSCL 12C

A method for estimating the density of the latent trait (or ability) in an item response model is given based on the logspline density estimator of Stone and Koo. In the implementation presented here, families of densities whose logarithms are quadratic splines are used to estimate the unknown latent trait density. The number of knots in the spline is variable permitting arbitrary densities to be well approximated from the logspline family. Because the family is exponential and contains all normal distributions, the likelihood ratio test can be used to test for normality. An ad hoc method is proposed for choosing the number of knots, and the method is illustrated with two simulated data sets. GRA

N89-14047# Stanford Univ., Calif. Dept. of Statistics.
DERIVING AND APPLYING IMPROVED UPPER BOUNDS FOR MULTIVARIATE NORMAL PROBABILITY OUTSIDE OF N-CUBES Technical Report No. 407
Donald R. Hoover 19 Jul. 1988 82 p
(Contract N00014-86-K-0156)
(AD-A198193) Avail: NTIS HC A05/MF A01 CSCL 12C

Two related improved Bonferroni methods to obtain upper bounds for the probabilities of unions of events are described. One procedure (bivariate method) uses probabilities of events and pairwise intersections of events. The other superior and more complicated procedure (trivariate method) uses probabilities of pairwise and three way intersections of events. These new methods are applied to multivariate normal hypothesis testing and simultaneous unbiased confidence intervals and are shown to give results superior to those of the currently used procedure (conservative assumption and independence of events) if the number of variables is not too large and the data is highly correlated. Modifications of these new methods to non-normal probabilities and different types of probability regions are also mentioned. GRA

N89-14048# North Carolina Univ., Chapel Hill.
A QUICK AND EASY MULTIPLE USE CALIBRATION CURVE PROCEDURE Technical Report No. 11, Aug. 1987 - Aug. 1988
R. J. Carroll, J. Sacks, and C. H. Spiegelman (National Bureau of Standards, Washington, D.C.) Aug. 1988 21 p
(Contract F49620-85-C-0144)
(AD-A198227; AFOSR-88-0843TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The standard multiple use calibration procedure due to Scheffe (1973) states that with probability 1-delta, the proportion of calculated confidence intervals containing the true unknowns is at least 1-alpha in the long run. The probability 1-delta refers to the probability that the calibration experiment results in a good outcome. In Scheffe's formulation a good outcome involves both coverage of the true underlying regression curve and an upper confidence limit for sigma, the scale parameter. Scheffe's procedure is fairly difficult for practitioners to apply because it relies on tables that are not easy to use. A simpler notion of goodness which only requires the calibration experiment to result in coverage of the underlying regression leads to easily calculated confidence intervals for the unknowns. In addition, these intervals are generally shorter than Scheffe's. An application example is given to illustrate the technique. GRA

N89-14049# Texas A&M Univ., College Station.
VARIANCE FUNCTION ESTIMATION IN REGRESSION: THE EFFECT OF ESTIMATING THE MEAN Technical Report No. 4, Aug. 1987 - Aug. 1988
Peter Hall (Australian National Univ., Canberra.) and R. J. Carroll Aug. 1988 18 p
(Contract F49620-85-C-0144)

(AD-A198228; AFOSR-88-0842TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The authors consider estimation of a variance function g in regression problems. Such estimation requires simultaneous estimation of the mean function f. We obtain sharp results on the extent to which the smoothness of f influences best rates of convergence for estimating g. For example, in nonparametric regression with two derivatives on g, classical rates of convergence are possible if and only if the unknown f satisfies a Lipschitz condition of order 1/3 or more. If a parametric model is known for g, then g may be estimated n 1/2 - consistently if and only if f is Lipschitz of order 1/2 or more. Optimal rates of convergence are attained by kernel estimators. GRA

N89-14050# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
WEIGHTED AND CLOUDED DISTRIBUTIONS
C. R. Rao Feb. 1988 41 p
(Grant AF-AFOSR-0030-88; AF Proj. 2304)
(AD-A198321; TR-88-01; AFOSR-88-0788TR) Avail: NTIS HC A03/MF A01 CSCL 12C

The concept of weighted distributions can be traced to the study of effects of methods of ascertainment upon the estimation of frequencies by Fisher in 1934. It was formulated in general terms by the author in a paper presented at the First International Symposium on Classical and Contagious Distributions held in Montreal in 1963. Since then a number of papers have appeared on the subject. This article reviews the previous work and the current developments with some examples. Weighted distributions occur in a natural way when adjustments have to be made in the original probability distribution due to deviations from simple random sampling in collecting data, as when the events that occur do not have the same change of coming into the sample. The examples include: p.p.s (probability proportional to size) sampling in sample surveys, damage models, visibility bias in quadrat sampling in ecological studies, sampling through effected individuals in genetic studies, waiting time paradox and so on. GRA

N89-13916# Iowa State Univ. of Science and Technology, Ames.
P.C. CARP: VARIANCE ESTIMATION FOR COMPLEX SURVEYS
Dan Schnell, Gary Sullivan, William J. Kennedy, and Wayne A. Fuller *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 125-129 Sponsored in part by Census Bureau, Washington, D.C. (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12F

N89-13939# Bell Telephone Labs., Inc., Holmdel, N. J.
UPPER AND LOWER PROBABILITY: A GENERAL FRAMEWORK FOR MODELING UNCERTAINTY
Yves L. Grize *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 339-343 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13940# Colorado State Univ., Fort Collins.
THE NUMERICAL SOLUTION OF A SYSTEM OF ORDINARY STOCHASTIC DIFFERENTIAL EQUATIONS ON THE CYBER 205 SUPERCOMPUTER
Tim Haas *In its* Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 344-34 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13943# State Univ. of New York, Albany.
A LEISURELY LOOK AT THE MODELS OF UNCERTAINTY IN EXPERT SYSTEMS
Syni-An Hwang *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 359-362 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

N89-13944# Temple Univ., Philadelphia, Pa.
BOOTSTRAPPING KOLMOGOROV-SMIRNOV STATISTICS, 2
Alan Julian Izenman *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 363-366 (For primary document see N89-13901 05-60)
Avail: NTIS HC A20/MF A01 CSCL 12A

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N89-14051# Institute for Defense Analyses, Alexandria, Va.
EVALUATION OF COMPUTER-AIDED SYSTEM DESIGN TOOLS FOR SDI (STRATEGIC DEFENSE INITIATIVE) BATTLE MANAGEMENT/C3 (COMMAND, CONTROL AND COMMUNICATIONS) ARCHITECTURE DEVELOPMENT Final Report
Dennis W. Fife, Kevin Campbell, John Chludzinski, Nelson Corcoran, and Carlos Gonzalez 1 Oct. 1987 183 p
(Contract MDA903-84-C-0031)
(AD-A197452; AD-E500991; IDA-P-2062; IDA/HQ-87-32835)
Avail: NTIS HC A09/MF A01 CSCL 15C

This IDA Paper was prepared at the request of the Strategic Defense Initiative Organization. The paper documents findings of an evaluation on the capabilities of certain computer software computer-aided software engineering (CASE) tools to provide computer-aided graphic design of Battle Management/C3 for the SDIO. Each tool (of the five selected on the basis of the best available at this time), was installed at IDA. After training by vendor tool staff, an IDA team, using a hands-on design exercise determined the merits of the tools for SDI application. A comparative summary of the tools is given relative to envisaged SDI requirements and an extensive questionnaire is answered for each. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N89-14052*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ECONOMICAL SEMI-ANALYTICAL ORBIT THEORY FOR MICRO-COMPUTER APPLICATIONS
R. A. Gordon Washington, D.C. Mar. 1988 46 p
(NASA-TP-2811; Rept-86B0451; NAS 1.60:2811) Avail: NTIS HC A03/MF A01 CSCL 12A

An economical algorithm is presented for predicting the position of a satellite perturbed by drag and zonal harmonics J sub 2 through J sub 4. Simplicity being of the essence, drag is modeled as a secular decay rate in the semi-axis (retarded motion); with the zonal perturbations modeled from a modified version of the Brouwers formulas. The algorithm is developed as: an alternative on-board orbit predictor; a back up propagator requiring low energy consumption; or a ground based propagator for microcomputer applications (e.g., at the foot of an antenna). An O(J sub 2) secular retarded state partial matrix (matrizant) is also given to employ with state estimation. The theory was implemented in BASIC on an inexpensive microcomputer, the program occupying under 8K bytes of memory. Simulated trajectory data and real tracking data are employed to illustrate the theory's ability to accurately accommodate oblateness and drag effects. Author

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N89-14053*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A GENERAL FORMALISM FOR PHASE SPACE CALCULATIONS
John W. Norbury, Philip A. Deutchman, Lawrence W. Townsend, and Francis A. Cucinotta (Old Dominion Univ., Norfolk, Va.) Nov. 1988 23 p
(Grant NSF PHY-84-11009)
(NASA-TP-2843; L-16463; NAS 1.60:2843) Avail: NTIS HC A03/MF A01 CSCL 20C

General formulas for calculating the interactions of galactic cosmic rays with target nuclei are presented. Methods for calculating the appropriate normalization volume elements and phase space factors are presented. Particular emphasis is placed on obtaining correct phase space factors for 2-, and 3-body final states. Calculations for both Lorentz-invariant and noninvariant phase space are presented. Author

N89-14054# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
OPEN PROBLEMS IN CONDENSED MATTER PHYSICS, 1987
L. M. Falicov Aug. 1988 23 p Presented at the 3rd Symposium on Pan-American Collaboration in Experimental Physics, Rio de Janeiro, Brazil, 19-23 Oct. 1987 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE88-016622; LBL-25687; CONF-8710367-1) Avail: NTIS HC A03/MF A01

The 1970's and 1980's can be considered the third stage in the explosive development of condensed matter physics. After the very intensive research of the 1930's and 1940's, which followed the formulation of quantum mechanics, and the path-breaking activity of the 1950's and 1960's, the problems being faced now are much more complex and not always susceptible to simple modelling. The (subjectively) open problems discussed here are: high temperature superconductivity, its properties and the possible new mechanisms which lead to it; the integral and fractional quantum Hall effects; new forms of order in condensed-matter systems; the physics of disorder, especially the problem of spin glasses; the physics of complex anisotropic systems; the theoretical prediction of stable and metastable states of matter; the physics of highly correlated states (heavy fermions); the physics of artificially made structures in particular heterostructures and highly metastable states of matter; the determination of the microscopic structure of surfaces; and chaos and highly nonlinear phnomena. DOE

N89-14055# Texas Univ., Austin. Applied Research Lab.
INVITATION TO THE BISPECTRUM
Murray A. Wolinsky 8 Feb. 1988 93 p
(AD-A198411; ARL-TR-88-7) Avail: NTIS HC A05/MF A01 CSCL 12C

This bispectrum is examined from a variety of physical and mathematical perspectives. Particular stress is placed on those examples or approaches which aid intuitive understanding of the bispectrum and its properties. A key contribution of this work is the discovery and detailed development of a time series model which can reproduce any possible bispectrum. This model is used to discuss practical concerns relating to the bispectrum such as sampling and estimation issues. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N89-14056# Naval Underwater Systems Center, New London, Conn.
LOW FREQUENCY WIND GENERATED AMBIENT NOISE SOURCE LEVELS
D. J. Kewley, D. G. Browning, W. M. Carey, and W. A. VonWinkle 9 May 1988 15 p
(AD-A196925; NUSC-TD-8239) Avail: NTIS HC A03/MF A01 CSCL 20A

This report consists of 10 viewgraphs and accompanying brief narrative for each viewgraph. Most of the wind-generated low frequency ambient noise data have been taken recently in the Southern Hemisphere Oceans. Burgess and Kewley have obtained corresponding source levels that have been implemented in the DUNES Ambient Noise Prediction Model. A survey is made of historical Northern Hemisphere ambient noise data to refine this estimation of source levels. These results are compared with other reported wind-generated noise source levels. GRA

N89-14057# Stanford Univ., Calif.
ACOUSTIC SCATTERING AND PROPAGATION Final Report
Joseph B. Keller 23 Jun. 1988 6 p
(Contract N00014-85-K-0817)
(AD-A197054) Avail: NTIS HC A02/MF A01 CSCL 20A

The Born approximation was used to obtain in a unified way the first and second moments of the acoustic fields scattered by four kinds of slightly rough surfaces. The same problem was solved in a second way by the smoothing method and the results were exactly the renormalized ones obtained before. Thus, the Born expansion, the renormalized Born expansion, Twersky's method and the smoothing method are related. Various other projects on rough surface scattering were performed and their results are briefly presented. E.R.

N89-14058# Applied Research Lab., State College, Pa.
ACOUSTIC INTENSITY: ENERGY TRANSFER, WAVE PROPERTIES AND APPLICATIONS Ph.D. Thesis
Julian A. Mann, III Aug. 1988 181 p
(Contract N00024-85-C-6041)
(AD-A197399; TR-88-010) Avail: NTIS HC A09/MF A01 CSCL 20A

This study explores the physical interpretations of the instantaneous intensity, active intensity, and reactive intensity vectors in terms of energy transfer and wave properties in the nearfield of a general monochromatic sound field. The time dependent energy transfer is described by the instantaneous intensity, which contains contributions by the active intensity and the reactive intensity. The time independent intensity vectors are directly related to wave form properties. The active intensity vector is shown to be perpendicular to the resultant wave fronts and the reactive intensity is shown to point in the direction of decreasing pressure amplitude. Time dependent instantaneous intensity flux lines are drawn to show that in general the energy does not propagate with the resultant wave fronts. The speed of wave front propagation and the complex specific acoustic impedance are calculated from the nearfield measurements of the time independent intensity vectors and energy densities. Five measured examples are presented which show that the location of energy sources, resonators, diffraction, and interference effects are clearly determined from analyses of the active intensity, reactive intensity, and potential energy, kinetic energy, phase speed, and complex specific acoustic impedance. GRA

N89-14059# Texas Univ., Austin. Dept. of Mechanical Engineering.
PROBLEMS IN NONLINEAR ACOUSTICS: SCATTERING OF SOUND BY SOUND, PARAMETRIC ARRAYS, FOCUSED SOUND BEAMS, AND NONCOLLINEAR TONE-NOISE INTERACTIONS Annual Summary Report No. 3, 1 Jul. 1987 - 30 Jun. 1988

Mark F. Hamilton 1 Jul. 1988 23 p
(Contract N00014-85-K-0708)
(AD-A198755) Avail: NTIS HC A03/MF A01 CSCL 20A

Five projects are discussed involving nonlinear acoustics: (1) scattering of sound by sound, a theoretical study of two noncollinear Gaussian beams which interact to produce sum and difference frequency sound; (2) parametric receiving arrays, a theoretical and numerical study of parametric reception in a reverberant environment; (3) noncollinear interaction of a tone with noise, an experimental investigation of the nonlinear interaction which occurs when the two waves propagate in different modes of a rectangular duct; (4) nonlinear effects in focused sound beams, a preliminary analytical study of harmonic generation in the focal region; and (5) parametric ultrasonic proximity sensor, a numerical investigation into the use of a parametric array as an ultrasonic proximity sensor in air. GRA

N89-14060# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
NOISE AND SONIC BOOM IMPACT TECHNOLOGY. BOOMAP2 COMPUTER PROGRAM FOR SONIC BOOM RESEARCH, VOLUME 1 Final Report, Jul. 1986 - Nov. 1987
Emma G. Wilby, Jerold M. Haber, and Dwight E. Bishop Aug. 1988 89 p
(Contract F33615-86-C-0530)
(AD-A198892; BBN-6487-Vol-1; HSD-TR-88-001-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 20A

The BOOMAP2 and MOAOPS computer programs analyze noise from supersonic aircraft operations by extracting information from the ACMI/TACTS computer tapes. The MOAOPS program extracts information from a TACTS/ACMI mission standard data tape and compiles a computer library of information concerning the supersonic operations. The BOOMAP2 program utilizes the library produced by the MOAOPS program. The program calculates various statistics on the supersonic operations, and calculates expected sonic boom levels on the ground based on the extracted information. BOOMAP2 can: (1) generate various spatial/temporal distribution statistics; (2) interface with sonic boom generation and propagation models; (3) calculate the intensity and location of sonic booms reaching the ground; and (4) provide the data file used by a commercial graphical software package, GRCP, to plot contours of boom exposure in units of average peak overpressure or C-weighted day-night average sound level (CDNL). These two programs, when used with an adequate library of aircraft sorties from Military Operating Areas, can be an invaluable tool for environmental planning purposes to predict boom intensity, frequency, and distribution. This report describes the technical basis for the BOOMAP2 program developed under this contract. GRA

N89-14061# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
NOISE AND SONIC BOOM IMPACT TECHNOLOGY. BOOMAP2 COMPUTER PROGRAM FOR SONIC BOOM RESEARCH. VOLUME 2: PROGRAM USERS/COMPUTER OPERATIONS MANUAL Final Report, Jul. 1986 - Nov. 1987
Philip J. Day, Thomas M. Reilly, and Harry Seidman Aug. 1988 53 p
(Contract F33615-86-C-0530)
(AD-A198893; BBN-6488-Vol-2; HSD-TR-88-001-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 20A

The BOOMAP2 and MOAOPS computer programs analyze noise from supersonic aircraft operations by extracting information from a Tactical Air Combat Training System/Air Combat Maneuvering Instrumentation (TACTS/ACMI) mission standard data tape and compiles a computer library of information concerning the supersonic operations. The BOOMAP2 program utilizes the library produced by the MOAOPS program. The program calculates various statistics on the supersonic operations, and calculates expected sonic boom levels on the ground based on the extracted information. BOOMAP2 can: (1) generate various spatial/temporal distribution statistics; (2) interface with sonic boom generation and propagation models; (3) calculate the intensity and location of sonic booms reaching the ground; and (4) provide the data file used by a commercial graphical software package, GPCP, to plot contours of boom exposure in units of average peak overpressure or C-weighted day-night average sound level (CDNL). These two programs, when used with an adequate library of aircraft sorties from Military Operating Areas, can be an invaluable tool for environmental planning purposes to predict boom intensity, frequency, and distribution. This report provides the program user's manual and computer operation's manual for the BOOMAP2 program developed under this contract. GRA

N89-14062# Georgetown Univ., Washington, D.C. Dept. of Physics.
CHANGES IN ULTRASONIC PULSE SHAPES DUE TO NONLINEAR PROCESSES Final Report, 1 Aug. 1985 - 31 Jul. 1988
Walter G. Mayer, J. Wolf, and T. D. Ngoc 31 Jul. 1988 90 p
(Contract N00014-86-K-0624)
(AD-A198274) Avail: NTIS HC A05/MF A01 CSCL 09F

Acoustooptic interaction theory is applied to ultrasonic pulses in order to determine pulse parameters from the light diffraction pattern produced by the pulses. Experiments are described to show how pulse shapes change when propagation is in a nonlinear liquid. It is shown that pure electronic determinations of pulse shapes do not describe all the changes accurately whenever the probe response is not known exactly. Use of the present method is able to eliminate this problem. Examples of pulse propagation as investigated by acoustooptic method are given and evaluated. GRA

N89-14063*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIPLE POINT LEAST SQUARES EQUALIZATION IN A ROOM Final Report
S. J. Elliott and P. A. Nelson (Southampton Univ., England) Oct. 1988 25 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181733; ICASE-88-61; NAS 1.26:181733) Avail: NTIS HC A03/MF A01 CSCL 20A

Equalization filters designed to minimize the mean square error between a delayed version of the original electrical signal and the equalized response at a point in a room have previously been investigated. In general, such a strategy degrades the response at positions in a room away from the equalization point. A method is presented for designing an equalization filter by adjusting the filter coefficients to minimize the sum of the squares of the errors between the equalized responses at multiple points in the room and delayed versions of the original, electrical signal. Such an equalization filter can give a more uniform frequency response over a greater volume of the enclosure than can the single point equalizer above. Computer simulation results are presented of equalizing the frequency responses from a loudspeaker to various typical ear positions, in a room with dimensions and acoustic damping typical of a car interior, using the two approaches outlined above. Adaptive filter algorithms, which can automatically adjust the coefficients of a digital equalization filter to achieve this minimization, will also be discussed. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N89-14064# Utah Univ., Salt Lake City. Dept. of Chemistry.
TOTAL INTERNAL REFLECTION FLUORESCENCE FOR ADSORBED PROBE MOLECULE STUDIES OF LIQUID/SOLID INTERFACIAL ENVIRONMENTS Technical Report, Sep. 1987 - Jul. 1988
K. C. Hartner, J. W. Carr, and J. M. Harris 15 Jul. 1988 27 p
(Contract N00014-85-K-0712)
(AD-A197423) Avail: NTIS HC A03/MF A01 CSCL 07D

Total internal reflection fluorescence (TIRF) is developed as a surface selective method to allow the environment of a liquid-solid

interface to be probed by fluorescent molecules which are adsorbed from solution. The method has been used to detect pyrene sorbed to an octadecylsilane derivatized, fused silica plate and resolve its spectral emission so that vibronic intensity ratios can be calculated and the surface environment characterized. Adsorption equilibria of the fluorescent probe to the surface and the depth of penetration of the evanescent excitation beam provide the basis for predicting interference from probe molecules in the solution phase. These predictions were validated by replacing the solution overlaying the alkylated silica interface with saturate vapor and comparing the apparent surface environment. GRA

N89-14065# Ohio Univ., Athens. Dept. of Physics and Astronomy.
THEORY OF PHOTON AND ELECTRON INDUCED REACTIONS Progress Report, 1 Jul. 1986 - 30 Jun. 1987
David S. Onley and Louis E. Wright Jul. 1988 8 p
(Contract DE-AC02-79ER-10397)
(DE88-014028; DOE/ER-10397/8) Avail: NTIS HC A02

During the third year of our three-year contract from the Department of Energy, we have made considerable progress or have completed our studies on the following aspects of the general investigation of electron and photon induced reactions; photo- and electro-production of mesons; the radiation tail accompanying elastic electron scattering and pair production; studies involving relativistic shell model; and electrofission coincidence angular distributions. We will report on each of these developments in this paper. DOE

N89-14066# Boston Univ., Mass. Dept. of Physics.
RESEARCH ACCOMPLISHMENTS IN PARTICLE PHYSICS Annual Progress Report
10 Apr. 1988 97 p
(Contract DE-AC02-86ER-40284)
(DE88-013984; DOE/ER-40284/T1) Avail: NTIS HC A05/MF A01

This document presents our report of the research accomplishments of Boston University researchers in six projects in high energy physics research: Colliding Beams Physics; Proton Decay; Monopole Detection with MACRO; Precision Muon G-2 Experiment; Accelerator Design Physics; and Theoretical Physics. DOE

N89-14067# Virginia Univ., Charlottesville. Dept. of Physics.
STRUCTURE DYNAMICS OF EXCITED ATOMS Final Technical Report, 1 Oct. 1986 - 30 Sep. 1988
T. F. Gallagher 28 Mar. 1988 3 p
(Grant AF-AFOSR-0005-87; AF Proj. 2301)
(AD-A198147; AFOSR-88-0846TR) Avail: NTIS HC A02/MF A01 CSCL 14B

The instrumentation grant was used to acquire three types of equipment. First we have purchased a high repetition rate Lambda-Physik eximer laser which we are using to pump several dye lasers. The eximer laser is particularly attractive as a pump laser for blue dye lasers. The eximer laser has been in constant use since June 1987, and we are now trying to improve our dye lasers to allow them to run at the 100 Hz repetition rate of the eximer laser. The second major category of equipment we have purchased is radio frequency and microwave equipment. We have acquired a new Hewlett Packard (HP) sweep oscillator to replace our existing oscillator which is now 15 years old. Specifically we have purchased and HP 8350 mainframe and plug-in units to cover the ranges 2 to 8, 8 to 18, and 18 to 25 GHz. These are entirely solid state devices which can, if need be, be phase locked to an external crystal controlled counter. The third kind of equipment is signal acquisition and averaging equipment. Specifically we have bought a fast 350 MHz Tektronix oscilloscope for diagnosing fast signals, especially photoelectron signals, and a 150 MHz digitizing, averaging oscilloscope which enables us to record time resolved data in a particularly efficient fashion. One can record the entire time resolved signal after each laser shot, raising the effective data collection efficiency by a factor of fifty relative to using a boxcar averager as we now do. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N89-14068# Brookhaven National Lab., Upton, N. Y.
THE AGS BOOSTER CONTROL SYSTEM
R. Frankel, E. Auerbach, B. Culwick, T. Clifford, S. Mandell, R. Mariotti, C. Salwen, and N. Schumburg 1988 3 p Presented at the 1st European Particle Accelerator Conference, Rome, Italy, 7 Jun. 1988
(Contract DE-AC02-76CH-00016)
(DE88-013990; BNL-41438; CONF-880695-44) Avail: NTIS HC A02

Although moderate in size, the Booster construction project requires a comprehensive control system. There are three operational modes: as a high intensity proton injector for the AGS, as a heavy ion accelerator and injector supporting a wide range of ions and as a polarized proton storage injector. These requirements are met using a workstation based extension of the existing AGS control system. Since the Booster is joining a complex of existing accelerators, the new system will be capable of supporting multiuser operational scenarios. A short discussion of this system follows. DOE

N89-14069# Pacific Northwest Labs., Richland, Wash.
ROTATING SOLID RADIATIVE COOLANT SYSTEM FOR SPACE NUCLEAR REACTORS
W. J. Apley and A. L. Babb May 1988 7 p Presented at the 24th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Boston, Mass., 11 Jul. 1988
(Contract DE-AC06-76RL-01830)
(DE88-016312; PNL-SA-15433; CONF-880764-4) Avail: NTIS HC A02/MF A01

The RING power system described in this paper is proposed as a primary or emergency heat rejection system for advanced space reactor power applications. The system employs a set of four (4) counter-rotating, 90 degree offset, coolant-carrying rings. The rings (segmented, corrugated, finned, thin-walled pipes, filled with liquid lithium) pass through a cavity heat exchanger and reradiate the absorbed heat to the space environment. DOE

N89-14070# Naval Research Lab., Washington, D.C.
ASYMPTOTIC GROWTH OF CUMULATIVE AND REGENERATIVE BEAM BREAK-UP INSTABILITIES IN ACCELERATORS Interim Memo Report
Y. Y. Lau 28 Jun. 1988 19 p
(AD-A198072; NRL-MR-6237) Avail: NTIS HC A03/MF A01 CSCL 20G

It is found that the asymptotic growth of the cumulative beam break up instability is independent of the focusing magnetic field, according to the model of Panofsky and Bander. The analysis is extended to include the transition from the cumulative to the regenerative type, both in the presence and absence of a focusing magnetic field. GRA

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N89-14071 Council for National Academic Awards (England).
THE MEASUREMENT OF SURFACE TOPOGRAPHY FROM LIGHT SCATTER Ph.D. Thesis
Francis Sweeney 1987 327 p
Avail: Univ. Microfilms Order No. BRD-81427

The effects that different characteristics of the machined surface have on the resultant scattered intensity distribution were investigation in order that more information about the surface can be extracted from optical scatter measurements. From a review

of optical scatter theory, purely formal treatments of relating the scattered intensity to the scattering surface scatter is presented which overcome many of the limitations imposed by strict theoretical treatments, allowing surfaces with any desired height and spatial character to be analyzed. The simulation technique has the additional advantage in that it works directly on the profile, consequently, it forms the framework for providing a necessary link between optical scatter and traditional stylus measurements. Investigating the scattering characteristics of surfaces ranging from deterministic to nondeterministic has shown that light scatter is influenced by the overall surface texture, and, in particular, the characteristics of the surface slopes. Additionally, the autocorrelation function of the scattered intensity is suggested as a good indicator of the spatial character of the surface. A practical application of the optical scatter analysis discussed is presented by an investigation of the finishing processes used in cylinder liner manufacture. Dissert. Abstr.

N89-14072# European Space Agency, Paris (France).
CALCULATIONS OF THE SNR OF A LASER DOPPLER ANEMOMETER WITH A CASSEGRAIN LENS
Friedrich Malota Jul. 1988 87 p Transl. into ENGLISH of Berechnungen des SNR bei einem Laser-Doppler-Anemometer mit Cassegrainoptik (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Jan. 1986 92 p Original language document was announced as N86-33157
(ESA-TT-1005; DFVLR-FB-86-12; ETN-88-93178) Avail: NTIS HC A05/MF A01; original German version available from DVFLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 13 Deutsche marks

The signal-to-noise ratios for laser Doppler anemometers are calculated. The backscatter volume for various diameters of lenses and for various intensity distributions is given. The interference for various waveforms and the resulting signal-to-noise ratios are calculated. ESA

N89-14073# European Space Agency, Paris (France).
BEAM QUALITY OF STABLE AND UNSTABLE RESONATORS: A THEORETICAL APPROACH
Thomas Hall Jul. 1988 61 p Transl. into ENGLISH of Theoretische Untersuchung der Strahlqualitaet bei Stabilen und Instabilen Resonatoren, Fed. Republic of Germany, DFVLR), Aug. 1987 Original language document was announced as N88-21826
(ESA-TT-1103; DFVLR-FB-87-35; ETN-88-93179) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 21 Deutsche marks

An iterative solution of the generalized Kirchhoff-Fresnel integral equation is used to determine the modes, near field, and far field distributions of resonators. The beam quality depends on the Fresnel number for stable and on the equivalent Fresnel number for unstable resonators, respectively. The laser channel partially shading the resonator mirror and the density variation in the gas flow diminish beam quality. Provisions which compensate the effect of a density variation are presented. ESA

N89-14074# State Univ. of New York, Buffalo. Dept. of Chemistry.
LIGHT SCATTERING BY A PHASE CONJUGATOR IN THE FOUR-WAVE MIXING CONFIGURATION
Henk F. Arnoldus and Thomas F. George Jun. 1988 51 p Submitted for publication
(Contract N00014-86-K-0043)
(AD-A197123; UBUFFALO/DC/88/TR-73) Avail: NTIS HC A04/MF A01 CSCL 20E

Reflection of travelling and evanescent plane waves by a four-wave mixing phase conjugator is studied in detail. No restrictions are imposed on the nonlinear interaction strength, the angle of incidence or the frequency mismatch between the pump beams and the incoming waves. The incident field is assumed to be weak compared to the pump fields, which justifies a classical-field description of the pumps. The wave vectors, amplitudes and phases for the various waves are evaluated, without the slowly-varying amplitude approximation. Familiar phase-matching resonances for certain values of the interaction length are recovered, and in addition strong resonances are found if the angle of incidence is finite, and the incident light is not in perfect resonance with the pumps. The latter resonances appear at the transitions from a travelling to an evanescent wave. The significance of finite angles of incidence and evanescent waves for spectroscopic applications is pointed out. GRA

N89-14075# Strathclyde Univ., Glasgow (Scotland). Div. of Thermo-Fluid and Environmental Engineering.
DEVELOPMENT OF A STRETCHABLE CONCAVE IMAGING MEMBRANE MIRROR OF VARIABLE FOCUS Final Technical Report, 6 Jan. 1987 - 6 Jan. 1988
P. Waddell 20 Mar. 1988 34 p
(Grant AF-AFOSR-0244-87; AF Proj. 2301)
(AD-A197228; EOARD-TR-88-08) Avail: NTIS HC A03/MF A01 CSCL 20F

The report describes the evolution of a plastic membrane, variable focus, concave imaging mirror, a zoom mirror. A partial vacuum behind the membrane is used to create a uniform pressure difference across the membrane and force it back into a concave shape. Range of curvatures (obtainable) is from the flat to F/0.5, the classical limit for imaging in concave mirrors. Plastic membranes have been metallized with surface roughnesses down to 10 angstroms, as good as any mirror polished to date. Shearing interferometry has been used to study mirror symmetry. Frames are being evolved to support the membrane in such a way that the mirrors will be interferometrically symmetrical and capable of excellent imaging. Plastic membranes can be obtained to 17 meters wide, enabling mirrors to around 50 feet in diameter to be built and capable of optical imaging. A space mirror has been built, capable of operation even in a total vacuum. The mirrors are vacuum sealed and can retain any one curvature for long periods of time. The mirrors have been used with gas lasers to create very large sized holograms and white light holograms. GRA

N89-14076# Naval Weapons Center, China Lake, Calif.
PHASE-SHIFT PARAMETERS AND SMALL VIBRATIONS IN RESONANT OPTICAL CAVITIES Final Report, May 1985 - Sep. 1985
D. M. Ross, C. Brune, and C. D. Marrs Sep. 1987 42 p
(AD-A197450; AD-E900761; NWC-TP-6776) Avail: NTIS HC A03/MF A01 CSCL 20F

An exact analysis has been performed on a three-mirror passive cavity reflectometer. GRA

N89-14077* National Aeronautics and Space Administration. Pasadena Office, Calif.
DYNAMIC RANGE COMPRESSION/EXPANSION OF LIGHT BEAMS BY PHOTOREFRACTIVE CRYSTALS Patent
Li-Jen Cheng, inventor (to NASA) and Hua-Kuang Liu, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 20 Sep. 1988 7 p Filed 24 Nov. 1987 Supersedes N88-24508 (26 - 17, p 2438)
(NASA-Case-NPO-17140-1-CU; US-Patent-4,772,785; US-Patent-Appl-SN-125021; US-Patent-Class-250-216; US-Patent-Class-350-354) Avail: US Patent and Trademark Office CSCL 20F

An apparatus is provided which greatly reduces the intensity of bright portions of an image while only moderately reducing the brightness of dimmer portions of the image, to thereby compress the range of light intensities to facilitate detection of the image. The apparatus includes a light detector device formed by a chip of photorefractive material. A 2-D array of light beams from an object to be detected passes through a beam splitter to form two arrays of light beams. The two arrays are directed at different angles against a surface of the chip of photorefractive material, the two arrays of light beams forming coincident images on the surface. One of the 2-D arrays of beams emerging from an opposite surface of the chip has a lower range of intensities, to facilitate detection of the object despite very bright spots in its image. The

other array of light beams emerging from the chip has a greater range of intensities than the unprocessed image of the object.
Official Gazette of the U.S. Patent and Trademark Office

N89-14078* National Aeronautics and Space Administration. Pasadena Office, Calif.
REMOTELY CONTROLLABLE REAL-TIME OPTICAL PROCESSOR Patent
Hua-Kuang Liu, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 20 Sep. 1988 6 p Filed 7 Nov. 1986 Supersedes N87-19064 (25 - 11, p 1520)
(NASA-Case-NPO-16750-1-CU; US-Patent-4,772,101; US-Patent-Appl-SN-927972; US-Patent-Class-350-337; US-Patent-Class-350-331-R; US-Patent-Class-350-342; US-Patent-Class-350-162.13; US-Patent-Class-382-31) Avail: US Patent and Trademark Office CSCL 20F

An optical processor is provided which facilitates selection of any of a variety of patterns or images which are to be compared with a Fourier transform of a template image, wherein the processor can be constructed at low cost. One of the two images that are to be compared is formed by generating video signals representing the image and using those signals to drive a liquid crystal array through which light passes.
Official Gazette of the U.S. Patent and Trademark Office

N89-14079# Naval Submarine Medical Research Lab., Groton, Conn.
SYMBOLIZING QUANTITATIVE DIFFERENCES ON COLOR CRTS Interim Report
Matthew McGranaghan 28 Apr. 1988 22 p
(AD-A198718; NSMRL-1115) Avail: NTIS HC A03/MF A01 CSCL 09A

This study examined the use of brightness to encode ordinal differences between symbols on CRT screens. The symbols were either U.S. states on a choropleth map or simple rectangles. The effects of background color and brightness were also measured. These results were related to the conventional practice with printed maps. Subjects compared pairs of symbols with different brightnesses, displayed on three background colors each of which had three brightnesses, and chose as quickly as possible which of the pair of symbols indicated more. On both the maps and the rectangles, subject responses indicated that the darker symbols meant more. These CRT results are consistent with the convention used with printed maps. GRA

N89-14080# Colorado State Univ., Fort Collins.
SUB-MICRON CARBON FILAMENTS FOR OPTICAL APPLICATIONS Final Report, 15 Jul. 1986 - 14 Nov. 1987
Ian L. Spain, Carol M. McConica, and J. Hager (Air Force Office of Scientific Research, Bolling AFB, Washington, D.C.) Nov. 1987 244 p
(Contract F49620-86-C-0083)
(AD-A198878; AFOSR-88-0290TR) Avail: NTIS HC A11/MF A01 CSCL 11B

The objective of this work was to study the growth and physical properties of carbon fibers prepared by the ion-bombardment of carbon surfaces, with particular reference to optical obscuration applications. During the contract period, it was decided to include another class of carbon fibers grown by catalytic-chemical-vapor-deposition (CCVD). This initial work showed that submicron diameter filaments of high aspect ration could be grown. GRA

N89-14081# Rome Air Development Center, Griffiss AFB, N.Y.
THE NUMERICAL EVALUATION OF A PHYSICAL OPTICS NORMALIZED CROSS SECTION FOR A ROUGH SURFACE Report, Apr. - Nov. 1987
Robert J. Papa and Margaret Woodworth Jan. 1988 30 p
(AD-A198919; RADC-TR-87-280) Avail: NTIS HC A03/MF A01 CSCL 17I

One major topic in this report is the explanation of the numerical evaluation of the physical optics normalized cross section (sigma) of a one-dimensional rough surface. A second topic involves the comparison of the numerical evaluation of sigma with two other approximate evaluations of the physical optics integral representation for sigma. Some comparisons of these three representations for sigma are made as function of surface roughness and mean surface slope. A general integral expression for sigma for a one-dimensional rough surface is analyzed and its is shown how it may be evaluated numerically. The single integral approximation is shown to require small surface slopes for good agreement whereas the geometric optics solution requires both small slopes and large Rayleigh parameter. GRA

N89-14082# Coast Guard Research and Development Center, Groton, Conn.
RESULTS OF A TROPICAL TEST OF A SHORE BASED MID RANGE INFRARED CAMERA Final Report
M. R. Wroblewski May 1988 46 p
(AD-A199099; RDC-12/88; USCG-D-16-88) Avail: NTIS HC A03/MF A01 CSCL 17E

A forward looking infrared device (FLIR) operating at 3.5 to 5 microns was tested for comparison against a previously tested FLIR operating at 9 to 12 microns. Results from both tests are used to compare operating ranges of the devices in the tropics. Theory suggests an increased detection and recognition range should be possible by using the mid infrared region. A low infrared profile, 110' Coast Guard patrol boat, served as a target for the mid infrared tests. Tests were conducted off the northern coast of San Juan, Puerto Rico, with temperature and relative humidity conditions similar to those experienced during earlier tests of the far infrared camera. The target vessel was consistently detectable at a range of 7 nmi and sometimes detectable at a range of greater than 10 nmi. Previous similar tests with the far infrared camera found typical detection ranges were less than 5 nmi even with large vessels. The low profile target vessel was recognizable (classifiable) at a range of 3 nmi. Similar recognition tests with the far infrared camera found typical recognition ranges from 1 nmi with small vessels to a maximum of 3 nmi for large vessels. The mid infrared camera outperforms the far infrared cameras in tropical conditions. GRA

N89-14083# Lawrence Livermore National Lab., Calif.
GALLIUM ARSENIDE INTEGRATED OPTICAL DEVICES IN ADVERSE ENVIRONMENTS
G. McWright, M. Lowry, E. Behymer, W. Brazes, G. Lancaster, and F. Roeske Nov. 1987 6 p Presented at the International Symposium on the Technologies for Optoelectronics, Cannes, France, 16 Nov. 1987
(Contract W-7405-eng-48)
(DE88-014485; UCRL-97806; CONF-871161-2) Avail: NTIS HC A02

We discuss preliminary measurements of the response of gallium arsenide integrated optical-waveguides to radiation from a Febetron. The Febetron produces electrons in the 300 to 700 keV range in approximately 3-ns FWHM pulses, with a maximum dose rate of approximately 10 to the 14th rad/sec. Prompt radiation effects were monitored on a streak camera recording system. DOE

N89-14084# Edgerton, Germeshausen and Grier, Inc., Goleta, Calif.
TRANSMISSION BANDWIDTH IMPROVEMENT USING IN-FIBER RAMAN AMPLIFICATION
Cheng-Huei Lin and Melvin A. Nelson 1988 10 p Presented at the International Symposium on the Technologies for Optoelectronics, Cannes, France, 16 Nov. 1987
(Contract DE-AC08-83NV-10282)
(DE88-014955; EGG-10282-2196; CONF-871161-1) Avail: NTIS HC A02/MF A01

The objective of the in-fiber optical amplification work is to improve the recordability of fast, weak analog diagnostic signals by increasing their intensity. Linear amplification is achieved using the backward stimulated Raman scattering process in a fiber lightguide data link. Feasibility of this technique was experimentally demonstrated and reported last year. Further studies and

investigations carried out recently have been aimed at development of a practical multichannel in-fiber amplification technique that will enable acquisition of weak single-transient pulses transmitted over kilometer-length data links. We report here the results of this work, including an interesting observation of enhanced bandwidth in the amplified, versus the unamplified, received signal. DOE

N89-14085# Sandia National Labs., Albuquerque, N. Mex. Microsensor Div.
FIBER RING RESONATORS AND SHOCK EXCITED MECHANICAL OSCILLATORS
M. A. Butler 1988 4 p Presented at the Electrochemical Society Fall Meeting, Chicago, Ill., 9 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-009854; SAND-88-1102C; CONF-881061-1) Avail: NTIS HC A02/MF A01

This paper discusses how a fiber ring resonator operates. DOE

N89-14086# Brookhaven National Lab., Upton, N. Y. Biology Dept.
CHARACTERIZATION OF IMPERFECTIONS IN THIN-FILM MULTILAYER DEVICES
A. M. Saxena 1988 8 p Presented at the 32nd International Technical Symposium on Optical and Opto-Electronic Applied Sciences and Engineering, San Diego, Calif., 14 Aug. 1988
(Contract DE-AC02-76CH-00016)
(DE88-016733; BNL-41688; CONF-880887-11; BIO-4469) Avail: NTIS HC A02/MF A01

The fabrication of high reflectivity multilayer monochromators usually involves depositing a greater number of bilayers than the calculated number for perfect multilayers. This deviation from ideal behavior occurs due to the presence of imperfections in layers. The imperfections are strongly dependent on the deposition process employed and the parameters during deposition. An understanding of the types of imperfections present may lead to attempts to minimize them. The imperfections should be taken into consideration for determining the sequence of d-spacing for making a supermirror. DOE

N89-14087# Lawrence Livermore National Lab., Calif.
NEW ORGANIC MATERIALS FOR EFFICIENT HARMONIC GENERATION OF NEAR ULTRAVIOLET LIGHT
Stephan P. Velsko, Laura E. Davis, Francis Wang, and David Eimerl 22 Aug. 1988 14 p Presented at the 32nd International Technical Symposium on Optical and Opto-Electronic Applied Sciences and Engineering, San Diego, Calif., 14 Aug. 1988
(Contract W-7405-eng-48)
(DE88-017010; UCRL-98121; CONF-880887-13) Avail: NTIS HC A03/MF A01

Water soluble organic salts comprise a large class of crystalline materials containing many efficient harmonic generators for producing blue and near ultraviolet light. Among the salts of simple chiral organic acids and bases, about 1 in 10 crystals has a nonlinearity greater than or equal to KDP. The distribution of noncritical wavelengths among these crystals peaks around 500 nm for Type I doubling and 700 nm for Type II. We estimate the number of chiral organic salts which must be examined in a survey in order to assure with high probability that an optimized crystal for a given frequency conversion process will be found. DOE

N89-14088# International Centre for Theoretical Physics, Trieste (Italy).
NON-INTERFERENCE AND NON-DIFFRACTION GRATING
Shaomin Wang, Qiang Lin, and Xuanhui Lu (Hangzhou Univ., China) Dec. 1987 4 p
(DE88-703519; IC-87/379) Avail: NTIS (US Sales Only) HC A02/MF A01

A non-interference and non-diffraction grating with right angle grooves is designed and made. Clear one to one non-Gaussian imaging is obtained and it has the ability to compensate distortions. It is a new optical device with unit magnification that could be used on compact copy machine. DOE

N89-14089# APA Optics, Inc., Blaine, Minn.
ATOMIC LAYER CHEMICAL VAPOR DEPOSITION OF AlxGa1-xN FOR SOLAR BLIND UV-DETECTORS Final Report
M. A. Khan 10 May 1988 10 p
(Contract N00014-87-C-0841)
(AD-A198181) Avail: NTIS HC A02/MF A01 CSCL 20B

APA Optics completed a program aimed at developing aluminum gallium nitride materials technology using atomic layer epitaxy. The key objective of the Phase I work was to study the nitrogen vacancy problem using a unique switched atomic layer MOCVD approach as the growth technique. These nitrogen vacancies result in extremely high carrier densities in single crystal epitaxial layers of GaN thereby rendering the material unusable for emitters (such as electroluminescent devices) or detectors (such as photoconductors or Schottky barriers). Four tasks were completed under Phase 1 program. Under the first task we designed and incorporated a unique silicon carbide coated graphic substrate in our low procures MOCVD system. This susceptor was designed to implement the switched atomic layer epitaxy approach. Program Task 2 focussed at growing single Layers of AlxGa1-xN (over entire x) using a standard low pressure MOCVD approach. We were successful in growing high quality single crystal layers. These layers were checked for single crystal nature (using Laue and RHEED), carrier concentrations and mobilities (using Van der Pauw and Hall measurements) and optical transmissions. These data as shown indicate material growth matching some of the best reported values in literature. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N89-14090# Nagoya Univ. (Japan). Inst. of Plasma Physics.
HIGH INTENSITY Li BEAMS FOR PROBE LASER SPECTROSCOPY Ph.D. Thesis
Hitoshi Yamaoka Jun. 1988 99 p
(IPPJ-874; ISSN-0469-4732) Avail: NTIS HC A05/MF A01

High intensity Li beams which combine a laser blow-off beam and a fast beam have been developed for plasma diagnostics with the combination of beam probe and laser spectroscopy, especially for the measurement of magnetic field strength. A novel technique is used to measure magnetic field strength based on laser blow-off Li beam probing combined with Doppler-tuned laser spectroscopy. A low energy beam is produced with a simple laser blow-off method. The density of the Li beam produced by blowing off a thin Li film is of the order of 10 to the 10th per cu cm, which is measured by the laser-induced fluorescence method. The beam energy is found to have a nearly Maxwellian velocity distribution with a translational energy of a few eV. The time duration of the beam is a few hundred microsec. The measured strength of the magnetic field is from a few tens of Gauss to 1 Tesla with an error of 10 percent. Time resolution is a few tens of microsec. Considering the attenuation of this beam, it is applicable for plasma where the line-integrated electron density is less than 5 x 10 to the 13th per sq cm. A Li source of the discharge type was used to produce a high energy and high current beam. Author

N89-14091# Texas Univ., Austin. Inst. for Fusion Studies.
TRAPPED PARTICLE INSTABILITY AND FLUTE INSTABILITY IN TANDEM MIRROR; SCALE SEPARATION CLOSURE IN ALFVEN WAVE TURBULENCE Ph.D. Thesis
Changye Chen Aug. 1988 165 p
(Contract DE-FG05-80ET-53088)
(DE88-015349; DOE/ET-53088/334; IFSR-334) Avail: NTIS HC A08/MF A01

A quadratic dispersion relation has been constructed, in which various MHD and kinetic effects like ion diamagnetism, electron diamagnetism, electron-electron electron-ion collisions, ion Landau-damping, E x B drift and energetic particles are included

and treated in a systematic way. The numerical study in which this formalism is used to investigate the two most likely instabilities in tandem mirror machines produced many quantitative and qualitative results about the two modes. A physically motivated, non-perturbative closure scheme is proposed to deal with some problems in plasma or fluid turbulence. After discussing a few simple analytically tractable applications, we have applied our formalism to a model problem: the shear-Alfven turbulence. The problem is readily solved numerically to obtain the turbulent spectrum. DOE

N89-14092# Texas Univ., Austin. Inst. for Fusion Studies.
SELF-SIMILAR EVOLUTION OF NONLINEAR MAGNETIC BOUYANCY INSTABILITY
K. Shibata, T. Tajima, and R. Matsumoto (Kyoto Univ., Japan) Jun. 1988 15 p
(Contract DE-FG05-80ET-53088)
(DE88-015534; DOE/ET-53088/322; IFSR-322) Avail: NTIS HC A03/MF A01

A new type of self-similar solution of ideal magnetohydrodynamics in the nonlinear stage of undular mode (k/parellel/B) of magnetic buoyancy instability (Parker instability or ballooning instability) is found through MHD simulation and theory. The solution has the characteristics of nonlinear instability in Lagrangian coordinates; the fluid velocity and the Alfven speed on each magnetic loop increases exponentially with time, because the loop is evacuated by the field aligned motion of matter due to gravitational acceleration. DOE

N89-14093# Lodestar Research Corp., Boulder, Colo.
FUNDAMENTAL STUDIES OF FUSION PLASMAS Annual Performance Report
R. E. Aamodt, P. J. Catto, D. A. Dlppolito, and J. R. Myra 23 Jun. 1988 23 p
(Contract DE-FG02-88ER-53263)
(DE88-012972; DOE/ER-53263/1) Avail: NTIS HC A03/MF A01

In this paper summary reports are given on significant new results for controlling and understanding tokamak equilibrium and stability under the application of high power ICH; the possibility of explaining and controlling high Z impurity injection in ICH auxiliary heated tokamaks; the development of a new transport and heating formalism including atomic processes and large amplitude ICH fields which is particularly applicable to tokamak edge plasmas; new results on the neoclassical transport of energetic alpha particles; and the initial evaluation of the potential for using atomic scattering events in the plasma as an explanation of enhanced plasma fluctuation radiation or as a diagnostic tool. DOE

N89-14094# Los Alamos National Lab., N. Mex. Center for Nonlinear Studies
MHD TURBULENCE: RELAXATION PROCESSES AND VARIATIONAL PRINCIPLES
David Montgomery and Lee Phillips (Dartmouth Coll., Hanover, N.H.) Jun. 1988 23 p Presented at the CNLS Conference on Advances in Fluid Turbulence, Los Alamos, N. Mex., 16 May 1988
(Contracts W-7405-eng-36; DE-FG02-85ER-53194)
(DE88-016341; LA-UR-88-2600; CONF-8805120-2) Avail: NTIS HC A03/MF A01

Turbulent relaxation processes seem to play a more prominent role in magnetohydrodynamics (MHD) than in hydrodynamics and exhibit a wider variety of behavior. In decaying turbulence, relaxed states can result from highly unequal decay rates of extensive, cascadable ideal invariants such as energy, magnetic helicity, etc. In externally driven MHD systems, the relaxed states may result from other processes, less well understood. We are exploring a formulation based on a principle of the minimum rate of energy dissipation. This is a nineteenth century principle from which seems to descend the more modern (and less well accepted) principle of the minimum rate of entropy production. Consequences of the conjectured principle are described for two cases: (1) for the reversed-field pinch (RFP), an externally-applied electric field supplies magnetic helicity at a constant rate; and (2) for the case of a constant rate of dissipation of cross-helicity, a relaxed state with aligned vorticity and current densities is predicted. The former problem models the steady-state operation of a familiar fusion confinement device. The latter models certain features of solar wind turbulence, regarded as a driven, steady-state system. DOE

N89-14095# International Centre for Theoretical Physics, Trieste (Italy).
POSSIBLE PARAMETRIC INSTABILITIES OF BEAT WAVES IN A TRANSVERSELY MAGNETIZED PLASMA
M. Salimullah May 1988 40 p Submitted for publication
(DE88-703857; IC-88/83) Avail: NTIS (US Sales Only) HC A03/MF A01

The effect of an external magnetic field on the various possible parametric instabilities of the longitudinal beat wave at the difference frequency of two incident laser beams in a hot plasma has been theoretically investigated. The kinetic equation is employed to obtain the nonlinear response of the magnetized electrons due to the nonlinear coupling of the beat wave with the low-frequency electrostatic plasma modes. It is noted that the growth rates of the three-wave and the four-wave parametric instabilities can be influenced by the external transverse magnetic field. DOE

N89-14096# Academy of Sciences of the Uzbek SSR, Tashkent. Inst. Yadernoj Fiziki.
TECHNIQUE FOR CALCULATING THERMAL EFFECT OF PULSED PLASMA FLOWS ON MATERIALS IN SIMULATION EXPERIMENTS
L. G. Gurvich, A. I. Fedorenko, and S. A. Shaposhnikov 1987 10 p In RUSSIAN
(DE88-703640; IYF-R-5-284) Avail: NTIS (US Sales Only) HC A02/MF A01

The method of calculation approach determination of thermal processes course during materials test on various plasma installations is described. Condition of large number of experiments allows according measured data of mass transfer and to nature of destructions on the surface to make conclusions about correspondence of these results to preliminary calculations (that confirms sufficient reliability of the latter). DOE

N89-14097# Illinois Univ., Urbana. Dept. of Nuclear Engineering.
OPENING SWITCH RESEARCH ON A PLASMA FOCUS 6 Final Report, 30 Sep. 1986 - 29 Sep. 1987
Glenn A. Gerdin 26 Feb. 1988 140 p
(Grant AF-AFOSR-0303-86; AF Proj. 2301)
(AD-A198155; AFOSR-88-0930TR) Avail: NTIS HC A07/MF A01 CSCL 20H

The utility of the plasma focus as an opening switch was analyzed on the basis of our previous experimental observations and those on other Mather-type devices, A load resistor has recently been included in the opening switch circuit model and the analysis indicates that the typical pinch resistances measured (approx. 1 ohm) are too small to drive typical load resistances encountered in pulsed power (approx. 1 ohm) in terms of % energy transferred (less than 2 percent) and the time required for the transfer (more than or = 200 ns). A scaling law for pinch stability has been derived, which is consistent with our data and that from several other experimental devices; this model predicts that a plasma focus could be designed to permit longer energy transfer times by increasing the anode radius. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N89-14098# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
EXPERIMENTAL STUDY OF ELECTRIC FIELD INFLUENCE ON LOW TEMPERATURE LONG-TIME RELAXATION IN CRYSTALLINE FERROELECTRICS
S. Sahling, M. Kolac, and A. Sahling 1987 19 p Submitted for publication
(DE88-702913; JINR-E-8-87-499) Avail: NTIS (US Sales Only) HC A03/MF A01

Calorimetric measurements with polycrystalline Pb(sub 0.915)La(sub 0.085).(Zr(sub 0.65)Ti(sub 0.35))O3 were performed at helium temperatures in electric field E (0 less than or equal to E less than or equal to 4.3 kV cm). Heat release after cooling from T(sub 1) (1.3 K less than or equal to T(sub 1) less than or equal to 35 K) to T(sub 0) = 1.3 K is very similar to that in amorphous metals and dielectrics. Experimental results disagree with the standard tunneling model. The observed release may be explained assuming the existence of a maximum energy is an element of epsilon sub f in the distribution function. The maximum relaxation time Tau sub max was found as a function of T(sub 1). A similar heat release is observed after switching on or off the electric field. Independent of T for 1.1 K less than or equal to T less than or equal to 3 K, proportional to E sup 2 with Tau sub max approx. E. No heat release was observed in the KH2PO4 single crystal. DOE

N89-14099# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
PHASE TRANSITION IN THE MODEL OF PROTON SUPERIONIC CRYSTAL
N. A. Dzhavadov and N. M. Plakida 1987 10 p In RUSSIAN; ENGLISH summary
(DE88-702948; JINR-R-17-87-553) Avail: NTIS (US Sales Only) HC A02/MF A01

A model for order-disorder phase transition for protons on hydrogen bonds in superionic conductor like cesium hydrogen sulphates is proposed. Possible types of proton ordering in the structural transition D sub 4h sup 19 yields C sub 2h sup 5, with doubling of the primitive cell volume are investigated by the concentration wave method. DOE

N89-14100*# Worcester Polytechnic Inst., Mass.
GROWTH OF LARGE ZEOLITE CRYSTALS IN SPACE
A. Sacco, Jr., A. Dixon, R. Thompson, G. Scott, and J. Dltr 1988 5 p
(Grant NAGw-976)
(NASA-CR-183262; NAS 1.26:183262) Avail: NTIS HC A02/MF A01 CSCL 20L

Synthesis studies performed using close analogs of triethanolamine (TEA) have shown that all three hydroxyl groups and the amine group in this molecule are necessary to provide nucleation suppression. Studies using C-13 nuclear magnetic resonance (NMR) revealed that the hydroxyl ions and the amine group are involved in the formation of an aluminum complex. It was also shown that silicate species fo not interact this way with TEA in an alkaline solution. These results suggest that successful aluminum complexation leads to nucleation in zeolite-A crystallization. B.G.

N89-14101 Stanford Univ., Calif.
VERTICAL BRIDGMAN GROWTH AND CHARACTERIZATION OF CdTe CRYSTALS Ph.D. Thesis
Yu-Chian Lu 1988 299 p
Avail: Univ. Microfilms Order No. DA8808385

The relationship between various growth parameters and the defect structure of CdTe crystals grown by the vertical Bridgman method was explored. The Microstructures of these crystals were extensively examined by chemical etching and synchrotoron X-ray topography (SXRT) methods. Surface analytical tools including Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), and low energy electron diffraction (LEED) were used to study polar (111)Cd and (111)Te surfaces subjected to various reducing and oxidizing treatments. Capacitance vs. voltage measurements on phosphorus-doped CdTe crystals were demonstrated to be a useful tool to probe the dopant incorporation, interface shape, and electrical homogeneity. Etch pit morphologies produced by various chemical etches could be explained by an adsorption poisoning dangling bond model which could also correctly predict the crystallographic polarity of CdTe crystals. The SXRT was found to be a valuable tool for studying the defect structure of both substrates and epilayers of CdTe as well as related compounds. A variety of defects were revealed, some of which could be observed only by this techinque. With the surface sensitivity of AES, we were able to distinguish the crystallographic polarity of CdTe crystals. The crystallographic polarity identified in this way was consistent with the results of the adsorption poisoning dangling bond model and other results from X-ray diffraction and transmission electron microscopy. Dissert. Abstr.

N89-14102# Wisconsin Univ., Madison. Dept. of Metallurgical and Mineral Engineering.
STABILITY OF AMORPHOUS METAL FILMS ON SEMICONDUCTOR SUBSTRATES
J. H. Perepezko and J. D. Wiley 1987 12 p
(Contract DE-FG02-84ER-45096)
(DE88-012567; DOE/ER-45096/3) Avail: NTIS HC A03/MF A01

In the culmination of work which began in June 1984, goals of this research have been as follows: Investigation of the stability of amorphous alloy films during diffusion and interdiffusion treatments. The atomic transport measurements will be conducted by a combination of RBS and AES techniques as explained in earlier reports. X-ray diffraction and transmission electron microscopy will be used for structural examination. Investigation of the electrical behavior of amorphous metal/semiconductor contacts, including both the interfacial electrical (Schottky barrier and Ohmic) behavior and the stability of the amorphous metallization against current-induced degradation by electro-migration. Fundamental studies of the electromigration process itself will be conducted in this broader context. Examination of structural relaxation during post-depression annealing will also take place. DOE

N89-14103# Battelle Memorial Inst., Columbus, Ohio.
MAGNETIC STUDIES OF A 1-2-3 (Y,Gd)-Ba-Cu-OXIDE SUPERCONDUCTOR
E. W. Collings, Peter J. Melling, Scott L. Swartz, Ralph D. Smith, Judith J. Rayment, Michael J. Pechan, and Marta Pardavi-Horvath (Ohio State Univ., Columbus.) 1987 6 p Presented at the 7th International Cryogenic Materials Conference, St. Charles, Ill., 14 Jun. 1987 Submitted for publication
(Contract DE-FG02-86ER-45281)
(DE88-010532; CONF-8706300-1; CONF-8706300) Avail: NTIS HC A02/MF A01

Magnetic susceptibility measurements have been conducted on a sample of the ceramic superconductor (Y sub 0.5 Gd sub 0.5) sub 1 Ba2Cu3O sub y (YGBC, T sub c = 92 K), the related compounds (Y sub 0.5 La sub 0.5) sub 1 Ba2Cu3O sub y (YLBC) and Y sub 1 Ba2Cu3O sub y (YBC), and the starting oxides Y2O3, La2O3, and CuO. It is deduced that the S = 12 moment exhibited by the antiferromagnetic CuO (T sub N = 560 K) is also present in YBC and YLBC and hence, presumably, in the YGBC. In the latter compound, any moment on the Cu is masked by the Gd's large moment (S = 72) which, according to both the susceptibility results and those of electron spin resonance studies which were also performed on the YGBC material, persists into the superconducting phase. Also reported are the results of vibrating sample magnetometer measurements taken under low-field-cycling conditions (about + or - 80 gauss) mostly in the Meissner flux-exclusion regime) within the temperature range 4.2 K to about 87 K. DOE

N89-14104# EG and G Energy Measurements, Inc., Goleta, Calif. Santa Barbara Operations.
COMPARISON OF TRANSPARENT CONDUCTING ELECTRODES ON MERCURIC IODIDE PHOTOCELLS
A. Y. Cheng and J. M. Markakis 1987 17 p Presented at the 6th International Workshop on Compound Semiconductors for Room Temperature X-ray and Nuclear Detectors, Davos, Switzerland, 14 Sep. 1987
(Contract DE-AC08-83NV-10282)
(DE88-014980; EGG-10282-2138; CONF-8709315-6) Avail: NTIS HC A03/MF A01

Three materials have been developed and tested which are suitable as transparent conducting-electrodes on mercuric iodide; aqueous ionic contacts of NaCl and LiCl, polyvinyl alcohol/phosphoric acid, and indium--tin--oxide (ITO). Polyvinyl alcohol/phosphoric acid is a conducting polymer and ITO is a wide band gap semiconductor. Photocell dimensions were in the range of 0.5 to 3.8 cm diam by about 1 mm thick. Photocells with these electrodes were evaluated for their spectral response in the range of 300 to 650 nm, response uniformity over the electrode activities area, leakage current and reliability. All units showed better than 75 percent quantum efficiency in the range 350 to 550 nm. Photodetector leakage currents ranged from 25 to 200 pA and have shown long term stability up to 1 year. DOE

N89-14105# Brookhaven National Lab., Upton, N. Y. Dept. of Physics.
ANTIFERROMAGNETISM IN YBa2Cu3O(SUB 6+x)
John M. Tranquada 1988 16 p Presented at the Joint INTERMAG: Magnetism and Magnetic Materials Conference, Vancouver, British Columbia, 12 Jul. 1988
(Contract DE-AC02-76CH-00016)
(DE88-015854; BNL-41521; CONF-880703-6) Avail: NTIS HC A03/MF A01

A number of models for high temperature superconductivity in the layered cuprate perovskites require strong antiferromagnetic superexchange interactions between Cu atoms. The existence of such interactions in La2CuO4(sub 4-y) has previously been demonstrated. A review is made of recent neutron scattering work performed at Brookhaven studying antiferromagnetism in RBa2Cu3O(sub 6-x) with R = Y, Nd. Measurements on ceramic samples with a range of oxygen concentrations have shown that 3-D antiferromagnetic ordering of the Cu spins occurs throughout the nonsuperconducting tetragonal phase, corresponding to 0 less than or equal to x less than or approx 0.4. Near x approx 0 the Cu(2+) atoms in the CuO2 layers form a simple Neel lattice, and there is no ordering of the nonmagnetic Cu(1+) atoms in the chain sites. With increasing oxygen content some of the Cu(1+) atoms are converted to Cu(2+) which leads to frustration of the interplanar coupling and eventually to a second type of ordering. Very recently, large single crystals of YBa2Cu3O(6+x) have been grown, making possible inelastic scattering studies of magnetic excitations. Spin waves within the CuO2 planes are observed to have a velocity approx greater than 0.5 eV angstroms. DOE

N89-14106# State Univ. of New York, Buffalo. Dept. of Chemistry.
COUPLED s-WAVE AND d-WAVE STATES IN THE HEAVY FERMION SUPERCONDUCTOR U SUB 1-xTh SUB xBe13
A. Langner, D. Sahu, and Thomas F. George Jun. 1988 22 p Submitted for publication
(Contract N00014-86-K-0043)
(AD-A197124; UBUFFALO/DC/88/TR-74) Avail: NTIS HC A03/MF A01 CSCL 20C

In the heavy fermion superconductor U(1-x)Th(x)Be13, superconducting states coexist for thorium concentrations O is less than or = to 0.06. Assuming s-wave and d-wave symmetries for these states, a Ginzburg-Landau free energy expression is derived which couples s- and d-wave states and is rotationally invariant, in contrast to the free energy expression proposed by Kumar and Wolfle (Phys. Rev. Lett. 59, 1954 (1987)). Discussed in detail are the consequences that follow from our free energy relation. In particular, one predicts that in the above system there are two eigenfrequencies associated with the dynamics of phase oscillations (internal Josephson effect) which are characteristic of the s-wave and d-wave states. GRA

N89-14107# Stanford Univ., Calif. Solid-State Electronics Lab.
RAPID THERMAL PROCESSING OF 3-5 COMPOUND SEMICONDUCTORS WITH APPLICATION TO THE FABRICATION OF MICROWAVE DEVICES Final Report, 1 Apr. 1985 - 31 Mar. 1988
James F. Gibbons May 1988 52 p
(Contract DAAG29-85-K-0054)
(AD-A197134; ARO-21616.8-EL) Avail: NTIS HC A04/MF A01 CSCL 20L

This research was focused on establishing better techniques for surface doping of 3 to 5 semiconductors. The GaAs doping techniques investigated in this work include Si surface diffusions using a solid source, ion implantation following by rapid thermal annealing, and both solid source and vapor phase Zn diffusions. New models for Si diffusion/electrical activation, and Zn diffusion have been developed and implementated in computer simulations. Using these rapid thermal diffusion techniques, it was possible to demonstrate that shallow n+ and p+ layers can be produced reliably while retaining excellent surface morphology. In addition, an improved understanding of the annealing of defects and electrical activation of dopants in ion implanted, amorphized GaAs has been achieved. GRA

N89-14108# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemistry.
PREPARATION AND CHARACTERIZATION OF SINGLE-CRYSTAL RBa2Cu3O(7-DELTA) (R=Er, Ho) Technical Report No. 31, 1 Jul. 1987 - 15 Jul. 1988
S. M. Fine and Martha Greenblatt 15 Jul. 1988 19 p
(Grants NSF DMR-84-04003; NSF DMR-87-14072)
(AD-A197173) Avail: NTIS HC A03/MF A01 CSCL 07B

Large (1.5 mm x 1.5 mm x 0.05 mm) single crystals of RBa2Cu3O7 delta (R = Er, Ho) were grown from nonstoichiometric mixtures of BaCO3-R2O3-CuO. Crystals of ErBa2Cu3O7 delta and HoBa2Cu3O7 delta grown in alumina crucibles have small orthorhombic distortions and are superconducting with resistive Tc (onsets) = 87 K and 80 K respectively. Crystals of ErBa2Cu3O7 delta grown in ZrO2 crucibles show an onset of diamagnetism at 82 K. A number of experiments were carried out in order to optimize the crystal growth parameters. GRA

N89-14109# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemistry.
ORTHORHOMBIC-TO-TETRAGONAL TRANSITION IN Re(1+x)Ba(2-x)Cu30(7+ DELTA) (Re=Nd, Sm AND Eu) Technical Report No. 30, 1 Jul. 1987 - 15 Jul. 1988
S. Li, E. A. Hayri, K. V. Ramanujachary, and Martha Greenblatt 15 Jul. 1988 21 p
(Grants NSF DMR-84-04003; NSF DMR-87-14072)
(AD-A197174) Avail: NTIS HC A03/MF A01 CSCL 07B

The orthorhombic-to-tetragonal structural phase transition in the high-Tc superconducting oxides of the type R1+xBa2-xCu3O7 delta (R (for rare earth) = Nd, Sm, and Eu) has been investigated using powder X-ray diffraction, dc resistivity, and thermogravimetric techniques. It was found that the orthorhombic-to-tetragonal transition occurs for samples whose nominal stoichiometric content of oxygen is greater than 7.0 (0 delta 0.3) as compared to less than 7.0 in YBa2Cu3O7 delta. With increasing (R/Ba) ratio in R1+xBa2-xCu30 delta, a clear convergence of multiple orthorhombic peaks to a well-defined single tetragonal peak was observed in the X-ray diffraction pattern. The presence or orthorhombic distortion in this system appears to be essential for achieving 90-K superconductivity. GRA

N89-14110# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemistry.
CHEMISTRY AND HIGH Tc SUPERCONDUCTIVITY IN THE La-Ba-Cu-O SYSTEM Technical Report No. 32, 1 Jul. 1987 - 15 Jul. 1988

Shu Li and Martha Greenblatt 15 Jul. 1988 9 p
(Grants NSF DMR-84-04003; NSF DMR-84-08266)
(AD-A197175) Avail: NTIS HC A02/MF A01 CSCL 07B

A systematic investigation of the chemistry and superconductivity in the La-Ba-Cu-O system was carried out, using X-ray powder diffraction, resistivity and TGA measurements. A phase diagram for the La-Ba-Cu-O quasi-ternary system at 950 C has been determined and the relationship between the phases in this system is discussed. A series of A-cation (ABO3-type perovskite) deficient compounds of the type of (LaBa2)xCu3O7.0 (0.67 less than x less than 0.96) were prepared. Cation deficiencies appear to stabilize the structure but depress Tc. Partial substitution of La and Ba in LaBa2CuO7 + delta by other rare earth and alkali earth cations, respectively, were also investigated. An enhancement in Tc, compared with La1+xBa2-xCu3O7 + delta was found in LaBa2-xCaxCu3O7 + delta (0 less than x less than 1.0), providing further evidence for the importance of reduced lattice dimensions in stabilizing the superconducting phase of La-123. GRA

N89-14111# Rutgers - The State Univ., New Brunswick, N. J.
EFFECTS OF FLUORINATION ON THE 90 K SUPERCONDUCTOR Ba2RCu30(7-DELTA) (R=Y,Eu; 0 LESS THAN DELTA LESS THAN 1) Technical Report No. 29, 1 Jul. 1987 - 15 Jul. 1988
S. M. Zahurak, S. M. Fine, D. W. Murphy, Martha Greenblatt, S. Nakahara, and W. W. Warren, Jr. (Bell Telephone Labs., Inc., Murray Hill, N. J.) 15 Jul. 1988 14 p
(Grant NSF DMR-84-04003)
(AD-A197176) Avail: NTIS HC A03/MF A01 CSCL 07B

Sintered pellets of Ba2RCu3O7-delta (R= Y,Eu; 0 less than or = delta is less than or = 1) were allowed to react with fluorine gas at temperatures between 200 and 300 C. Fluorination of Ba2YCu3O6.92 affords a nominal composition of BaYCu3O6.4F1.3 and Tc(onset) = 92K. Fluorination of Ba2YCu3O6.15 gives a nominal composition of Ba2YCu3O4.7F3.0, which is not superconducting to 4.2K. Fluorinated pellets appear to be single-phase as determined by X-ray powder diffraction. However, Raman, NQR, ESR, X-ray diffraction, and TEM data suggest that fluorine is not incorporated into the superconducting phase, but rather is incorporated into a secondary amorphous phase. GRA

N89-14112# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemistry.
NEW TERNARY RHENIUM CHALCOGENIDES WITH ISOLATED (Re6X8)-CLUSTER UNITS: PREPARATION AND PROPERTIES Technical Report No. 28, 1 Jul. 1987 - 15 Jul. 1988
G. Huan, M. Greaney, and Martha Greenblatt 15 Jul. 1988 12 p
(Grants NSF DMR-84-04003; NSF DMR-87-14072)
(AD-A197177) Avail: NTIS HC A03/MF A01 CSCL 07B

New ternary rhenium chalcogenides A4Re6X12 with A = T1, Cu, Na, Cs, and X = Se; A' = T1, Rb and X = S; A2Re6X12 with A = Pb and X = S, Se have been prepared by high temperature and ion exchange techniques in closed systems. X-ray diffraction powder patterns show them to be isostructural with previously reported A4Re6X12 which are characterized by Re6X8 cluster units interconnected into a three-dimensional network structure by X and X2 linkages. Temperature variation of resistivity measured on sintered pellets shows semiconducting behavior in agreement with 24 electrons per cluster filling the bonding valence bond which is separated in energy from the empty antibonding conduction band. Variation of the number and size of the A and X ions are correlated with structural stability in these compounds. GRA

N89-14113# University of Southern California, Los Angeles. Center for Laser Studies.
INFRARED ALL-OPTICAL IMAGE PROCESSING IN SEMICONDUCTORS USING THE NONLINEAR INDEX DUE TO DYNAMIC STATE-FILLING Final Report, Apr. 1985 - Apr. 1988
Elsa Garmire 31 May 1988 13 p
(Contract DAAG29-85-K-0082)
(AD-A197205; ARO-22364.15-PH) Avail: NTIS HC A03/MF A01 CSCL 20L

This project included basic studies of infrared nonlinear optical response and optical switching in semiconductor materials. Investigations ranged from the mid-infrared (InAs) through the 1.06 micron region (InP/based quaternaries) to the near-IR (GaAs/GaAlAs Multiple Quantum Wells). Mechanisms of dynamic state filling were explored; the study was extended to exciton resonance nonlinearities and finally the concept of enhanced carrier transport nonlinearities was introduced. This new non-local nonlinearity is due to the motion of optically induced charges within semiconductor depletion regions causing space change fields which decrease built-in fields. The optically induced change in internal fields causes nonlinear transmission due to electro-absorption, electro-refraction, and the quantum confined Stark effect. The result was the experimental demonstration of larger nonlinearities than have ever been previously measured, with a change of refractive index of 0.01 at an intensity level of 700 microwatts/sq cm. GRA

N89-14114# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Chemistry.
HIGH TEMPERATURE SUPERCONDUCTING FILMS BY SOL-GEL PREPARATION Technical Report, 1 Jul. 1987 - 15 Jul. 1988
M. Nagano and Martha Greenblatt 15 Jul. 1988 12 p
(Grants NSF DMR-84-04003; NSF DMR-87-14072.)
(AD-A197229) Avail: NTIS HC A03/MF A01 CSCL 07B

Superconducting oxide YBa2Cu3O7-delta was prepared by a sol-gel method, using nitrates or organometallic compounds as the starting reagents and ethylene glycol as the solvent. The processing parameters for gelation and pyrolysis were investigated. Single phase YBa2Cu3O7-delta was obtained when the as-prepared gel was heated above 900 C in air. Films were prepared by painting the gels on various substrates. The best superconducting films were obtained when the as-prepared gels were heated up to 950 C and annealed at 800 C on single crystals of SrTiO3 and at 550 C on Yttrium stabilized ZrO2 (YSZ) in O2, respectively. Films with Tc(zero) = 85 K were obtained on the (100) surface of single crystal SrTiO3; oriented films with Tc(zero) = 82 K on the (100) surface of YSZ formed. The films obtained from organic precursors showed Tc(onset) approx. 90 K; however, Tc(zero) was lower (approx. 50 K) than those of the films formed from nitrates. GRA

N89-14115# Florida State Univ., Tallahassee.
SECONDARY CRYSTALLIZATION IN POLYETHYLENES Technical Report No. 3
L. Mandelkern and R. G. Alamo 23 Jun. 1988 8 p
(Contract N00014-87-G-0185)
(AD-A197395) Avail: NTIS HC A02/MF A01 CSCL 07F

Changes in the phase structure of a set of rapidly crystallizing polyethylenes were studied over a long time period. The density is found to increase with time. Interpretation of the Raman internal mode spectra indicates, however, that the core crystallinity remains constant over this time period. The density changes reflect the fact that the partially ordered interfacial content increases at the expense of the liquid-like region. These continuing studies will set the basis for interpreting changes in properties of crystalline polymers over long-time periods. GRA

N89-14116# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemistry.
PREPARATION OF THE HIGH-Tc SUPERCONDUCTOR YBa2Cu3O(7-x) USING ORGANOMETALLIC PRECURSORS Technical Report No. 3
Leonard V. Interrante, Zhiping Jiang, and David Larkin 21 Jul. 1988 18 p
(Contract N00014-85-K-0632)
(AD-A197422) Avail: NTIS HC A03/MF A01 CSCL 07B

Organic soluble precursors to the high Tc 1-2-3 superconductor, YBa2Cu3O7-x, have been prepared using polyesters derived from

the interaction of citric acid (CA) or ethyl-enediaminetetraacetric acid (EDTA) with ethylene glycol. Mixtures of the nitrate, carbonate and/or acetate salts of the three metal ions with CA or EDTA and ethylene glycol were heated to obtain homogeneous green solids containing the desired 1:2:3 ratios of Y3+, Ba2+, and Cu2+ ions. Pyrolysis at 850 C to 960 C in oxygen gave the superconducting, orthorhombic, YBa2Cu3O7-x phase. Films of the superconductor were prepared by dropping ethylene glycol solutions of these precursors onto zirconia and alumina substrates, followed by pyrolysis to 950 C in O2. The results of TGA/DSC and FTIR studies of these precursors, as well as XRD, FTIR, pyrolysis/GC, electrical and magnetic property measurements on the pyrolysis products are presented and discussed in the context of the probable precursor structures and pyrolysis chemistry. GRA

N89-14117# Pittsburgh Univ., Pa. Dept. of Chemistry.
X-RAY PHOTOELECTRON SPECTROSCOPY STUDY OF Si-C FILM GROWTH BY CHEMICAL VAPOR DEPOSITION OF ETHYLENE ON Si(100) Technical Report No. 17
P. A. Taylor, M. Bozack, W. J. Choyke, and John T. Yates, Jr. 18 Jul. 1988 36 p
(Contract N00014-82-K-0280)
(AD-A197437; AD-E900740) Avail: NTIS HC A03/MF A01 CSCL 20E

The growth of a thin film of silicon carbide grown by chemical vapor deposition (CVD) of ethylene on Si(100) at 970 K was studied by X-Ray Photoelectron Spectroscopy (XPS). The growth of the film was observed through the behavior of the Si(2p) and C(1s) core levels and their plasmon losses. A 1.2eV (towards higher binding energy) shift is observed for the Si(p) binding energy between silicon in Si(100) and silicon in SiC. The plasmon loss energies measured as a function of film thickness below the C(1s) emission indicate that the C/Si ratio of the Si-C thickness below the C(1s) emission indicate that the C/Si ratio of the Si-C film throughout the CVD process is fairly constant. GRA

N89-14118# Duke Univ., Durham, N. C. Dept. of Chemistry.
THE TWIST-BOAT CONFORMATION IN A GALLIUM-ARSENIC SIX-MEMBERED RING: CRYSTAL STRUCTURE OF (Me3SiCh2)2(AsGaBr2)3
R. L. Wells, A. P. Purdy, A. T. McPhail, and C. G. Pitt 5 Jul. 1988 15 p
(Contract N00014-83-K-0572)
(AD-A197466; DU/DC/TR-08) Avail: NTIS HC A03/MF A01 CSCL 07C

The facile preparation, of a number of new gallium arsenic compounds, including (Me3SiCh2)2(AsGaBr2)3 using silylarsines was recently demonstrated by work in our laboratories, and is one of a group of mono(arsino)gallanes now known to exist as trimers on the basis of NMR and cryoscopic molecular weight data. GRA

N89-14119*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
METHOD AND APPARATUS FOR DETERMINING OPTICAL ABSORPTION AND EMISSION CHARACTERISTICS OF A CRYSTAL OR NON-CRYSTALLINE FIBER Patent Application
Charles E. Byvik, inventor (to NASA) and A. Martin Buoncristiani, inventor (to NASA) (Buoncristiani, A. Martin, Newport News, Va) 16 Aug. 1988 16 p
(NASA-Case-LAR-13963-1; NAS 1.71:LAR-13963-1; US-Patent-Appl-SN-232735) Avail: NTIS HC A03/MF A01 CSCL 20L

This invention relates generally to spectroscopy and, more particularly, to a method and apparatus for performing spectroscopic analysis of crystal and noncrystalline fibers. The invention provides a complete absorption curve for a material using a crystal fiber which can be more easily produced than the types of samples required for other methods of obtaining substantially the same absorption curve for identical materials. NASA

N89-14120*# National Aeronautics and Space Administration. Pasadena Office, Calif.
PREPARATION OF DILUTE MAGNETIC SEMICONDUCTOR FILMS BY METALORGANIC CHEMICAL VAPOR DEPOSITION Patent Application
Akbar Nouhi, inventor (to NASA) and Richard J. Stirn, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 23 Sep. 1988 28 p
(Contract NAS7-918)
(NASA-Case-NPO-17399-1-CU; NAS 1.71:NPO-17399-1-CU; US-Patent-Appl-SN-248019) Avail: NTIS HC A03/MF A01 CSCL 20L

A method for preparation of a dilute magnetic semiconductor (DMS) film is provided, in which a Group II metal source, a Group VI metal source and a transition metal magnetic ion source are pyrolyzed in the reactor of a metalorganic chemical vapor deposition (MOCVD) system by contact with a heated substrate. As an example, the preparation of films of Cd(sub 1-x)Mn(sub x)Te, in which 0 is less than or equal to x less than or equal to 0.7, on suitable substrates (e.g., GaAs) is described. As a source of manganese, tricarbonyl (methylcyclopentadienyl) manganese (TCPMn) is employed. To prevent TCPMn condensation during its introduction into the reactor, the gas lines, valves and reactor tubes are heated. A thin-film solar cell of n-i-p structure, in which the i-type layer comprises a DMS, is also described; the i-type layer is suitably prepared by MOCVD. NASA

N89-14121# Texas Univ., Austin. Microwave Lab.
ANALYSIS AND IMPROVEMENT OF mm-WAVE GaAs MESFET's
Samir M. El-Ghazaly and Tatsuo Itoh May 1988 100 p
(Contract DAAG29-84-K-0076)
(AD-A197189; Microwave-Lab-88-P-2; ARO-21438.43-EL) Avail: NTIS HC A05/MF A01 CSCL 20L

A two-dimensional computer model, which takes into account the nonstationary conditions, is used to investigate several aspects of the GaAs submicron-gate MESFET. First, this model is used to evaluate the effects of carrier injection into the MESFET buffer-layer. It is shown that the carrier of injection reduces the transconductance and increases the output conductance. One of the ways to reduce the carrier injection is to introduce a potential-barrier between the active-layer and the substrate. Therefore, the MESFET grown on a P-substrate is studied. It is shown that a high acceptor concentration in the substrate depletes large part of the active-layer and greatly reduces the output current. A more flexible design can be obtained by introducing a thin P-layer between the active-layer and the semi-insulating substrate. This model is also used in investigating the traveling Gunn domain phenomenon in GaAs MESFETs. It is shown that traveling domains exist in MESFETs with relatively thick active-layers. The propagation characteristics of these domains are studied in detail. A new structure called Inverted-Gate FET (INGFET) is studied as well. This structure has equal input and output reactances. Hence, it relaxes the restriction on the device width which becomes very severe in the mm-wave range. Another structure that employs carrier injection over a N + i junction and possesses equal input and output reactances is analyzed. It is called Inverted-Gate-Injection FET (INGIFET). GRA

N89-14122# Modena Univ. (Italy).
MONTE CARLO ANALYSIS OF QUANTUM TRANSPORT AND FLUCTUATIONS IN SEMICONDUCTOR 2 Final Technical Report, Feb. 1986 - Feb. 1988
Carlos Jacoboni, Lino Reggiani, Paulo Lugli, and Rosella Brunetti Feb. 1988 145 p
(Contract DAJA45-86-C-0004; DA Proj. 1L1-61102-BH-57)
(AD-A198686; R/D-5152-EE-01) Avail: NTIS HC A07/MF A01 CSCL 20L

The first topic treated is quantum transport. Two major lines of research have been investigated: the first is based on the introduction of the joint spectral density into a traditional Monte Carlo simulation; the second regards the formulation of a fully quantum mechanical approach for electron transport based on

the density matrix approach. The second treats noise, diffusion, and autocorrelation functions both from a theoretical and a simulative point of view. Results have been obtained for both bulk systems and quantum wells. The third topic concerns with an analysis of the effect of phonon populations in excess with respect to their thermal equilibrium values. Numerical Monte Carlo simulations have been performed for both GaAs and GaAs-AlGaAs quantum wells. GRA

N89-14123# Cambridge Univ. (England). Dept. of Engineering.
PROCESSING OF MIXED OXIDE SUPERCONDUCTORS
A. M. Campbell and M. F. Ashby 1987 35 p
(Contract DAJA45-87-C-0059)
(AD-A198754) Avail: NTIS HC A03/MF A01 CSCL 20C

High Tc superconductivity has continued to change at a rapid pace. Since the last report, two new compounds have been reported with even higher critical temperatures and possibly higher critical currents. Less encouraging is a recent experiment reported from IBM from which it appears that even clean low angle grain boundaries can limit the current densities. If confirmed, this means that in future all practical conductors will have to consist of carefully aligned grains, probably melted in some way to fuse the boundaries together. Fortunately, all the techniques developed in this project are applicable to a side range of materials. Most of the work is described in the three enclosed papers and only the main conclusions will be summarized in this report. GRA

N89-14124# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
SEMICONDUCTOR LASER DIODE ARRAYS BY MOCVD (METALORGANIC CHEMICAL VAPOR DEPOSITION) Final Report, 1 Sep. 1984 - 31 Aug. 1987
James J. Coleman 1 Sep. 1987 71 p
(Contract DAAK20-84-K-0225)
(AD-A198855) Avail: NTIS HC A04/MF A01 CSCL 20L

The purpose of this program is to develop the metalorganic chemical vapor deposition (MOCVD) epitaxial growth process for semiconductor heterostructure laser diode arrays. These laser diode arrays are intended to be used as an optical pump for solid state yttrium aluminum garnet (YAG) lasers. In particular, linear uniform arrays having high output power, high efficiency, low laser threshold current density and precisely controlled emission wavelength are required. There are three technical problems associated with this task. The first problem is development of individual laser diode device structures which satisfy the requirements for efficiency, threshold and wavelength control and are suitable for incorporation into laser arrays. There are a number of possible structures varying in complexity from conventional five-layer double heterostructures having alloy AlGaAs active regions to very sophisticated quantum well heterostructures (QWH). The second problem is an analytical study of the waveguide properties of multi-element laser arrays. Simple arrays of conventional double heterostructure laser diodes have been studied but extension of this work to other laser diode geometries is non-trivial. Preliminary and optimum geometries for the individual structures and the photomasks used for device processing require some modeling of the optical properties of these arrays. The third problem, and the major point of this entire program, is experimental development of suitably designed individual laser diode structures in a well modeled multielement array. GRA

N89-14125# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
JOSEPHSON JUNCTION ARRAYS WITH POSITIONAL DISORDER: EXPERIMENTS AND SIMULATIONS Technical Report No. 26
Martin G. Forrester Feb. 1988 136 p
(Contract N00014-83-K-0383; NSF DMR-81-04489; NSF DMR-86-14003)
(AD-A198938) Avail: NTIS HC A07/MF A01 CSCL 09A

The results of a study of Josephson junction arrays with positional disorder are presented, using both experiments and Monte Carlo simulations. We have fabricated 50 x 50 arrays of Pb/Cu proximity-effects junctions, with controlled positional disorder characterized by a parameter delta-star. The zero-field resistive transitions of these samples are well described by the Kosterlitz-Thouless-Halperin-Nelson vortex-unbinding theory. Measurements of resistance vs. magnetic field reveal rich structure, with pronounced minima at integer fields, as well as higher-order structure. In samples with disorders the principal oscillations are found to decay linearly with field, after accounting for the effect of the magnetic field on the critical currents of the individual junctions. We can quantify the destruction of phase-coherence on length-scales of order q times the lattice parameter by defining critical fields, fc(q) approx. 1/delta-star, by the disappearance of structures at fields fo= p/q, where fo is the average number of flux quanta per plaquette, and p and q are integers. Extrapolation to q=infinity yields an estimate of the critical field, f c, for the destruction of quasi-long-range phase coherence which is in good agreement with the theoretical prediction of Granato and Kosterlitz. However, our experiments show no evidence for the predicted reentrant phase transition. GRA

N89-14126# California Univ., Los Angeles. Dept. of Materials Science and Engineering.
SOLID-STATE PHASE EQUILIBRIA IN THE ZnS-CdS SYSTEM Technical Report No. 1
W. W. Chen, J. M. Zhang, A. J. Ardell, and B. Dunn 1 Sep. 1988 9 p
(Contract N00014-87-K-0531)
(AD-A198982) Avail: NTIS HC A02/MF A01 CSCL 07B

The ZnS-rich region of the ZnS-CdS phase diagram, up to 18 mol percent CdS, was studied over the temperature range 700 to 950 C, and the boundaries describing the equilibria between the sphalerite and wurtzite solid solutions were determined. X-ray diffraction analysis was the principal technique used, the phase boundaries being determined by the lattice-parametric and disappearing phase methods. The results indicate that the solubility of CdS in ZnS is extensive in both the sphalerite and wurtzite phases, with CdS stabilizing the wurtzite phase. GRA

N89-14127# California Univ., Los Angeles. Dept. of Materials Science and Engineering.
PHASE DIAGRAM STUDIES OF ZnS SYSTEMS Technical Report No. 2
J. M. Zhang, W. W. Chen, B. Dunn, and A. J. Ardell 1 Sep. 1988 8 p Presented at the SPIE Conference on Ceramics and Inorganic Crystals for Optics, Electro-Optics and Nonlinear Conversion, San Diego, Calif., Aug. 1988 Submitted for publication
(Contract N00014-87-K-0531)
(AD-A198983) Avail: NTIS HC A02/MF A01 CSCL 11B

The development of infrared-transmitting ZnS-based ceramics with a combination of high strength, hardness and toughness over a range of temperatures is highly desirable. The approach we are currently pursuing is a familiar one to metallurgists, namely the exploitation of thermal, and possibly mechanical, processing of ZnS-base alloys. Knowledge of the phase equilibria of various ZnS-rich systems is essential to achieve our objectives. Unfortunately, the literature on this subject is sparse, and we have had to undertake such investigations ourselves. This paper describes the results of our initial studies of the solid-state phase equilibria in the ZnS-CdS and ZnS-Ga2s3 phase diagrams. GRA

N89-14128# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
THE GROWTH OF GALLIUM NITRIDE FILMS VIA THE INNOVATIVE TECHNIQUE OF ATOMIC LAYER EPITAXY Annual Progress Report, 1 Jun. 1987 - 31 May 1988
Robert F. Davis, Michael J. Paisley, and Zlatko Sitar 1 Jun. 1988 31 p
(Contract N00014-86-K-0686)
(AD-A199055; NCSU/MTE-2) Avail: NTIS HC A03/MF A01 CSCL 07B

Gallium nitride (GaN) is a wide bandgap (3.45 eV at 300K) III-V compound semiconductor. The large direct bandgap and high

electron drift velocity of GaN are important properties in the performance of short wavelength optical devices and high power microwave devices. Immediate applications that would be greatly enhanced by the availability of GaN and/or AlxGa1-xN devices include threat warning systems (based on the ultraviolet (UV) emission from the exhaust plumes of missiles) and radar systems (which require high power microwave generation). Important future applications for devices produced from these materials include blue and ultraviolet semiconductor lasers, blue light emitting diodes (LEDs) and high temperature electronic devices. This report discusses this material. GRA

N89-14129# Chicago Univ., Ill. Dept. of Chemistry.
INELASTIC HELIUM SCATTERING STUDIES OF THE SURFACE VIBRATIONAL SPECTROSCOPY AND DYNAMICS OF ORDERED Ar, Kr AND Xe MULTILAYERS PHYSISORBED ON Ag(111) Interim Technical Report
K. D. Gibson and S. J. Sibener Jun. 1988 21 p Submitted for publication
(Contract N00014-86-K-0254)
(AD-A199088; TR-13) Avail: NTIS HC A03/MF A01 CSCL 07B

This is the second of three papers discussing our studies of overlayers of argon, krypton, and xenon physisorbed on Ag(111). All of these rare gases form ordered structures, which are azimuthally aligned but translationally incommensurate with the Ag substrate. In this paper, we discuss experiments which we utilized the angle resolved time of flight of inelastically scattered 18 meV He atoms to examine the surface dynamics of multilayer rare gas films along the r - M direction. This was done on a layer-by-layer basis for 2, 3, and greater than 20 layers for each of the rare gases. Unlike the monolayers, the vibrational modes observed for the multilayers show dispersion across the surface Brillouin zone, the amount of dispersion increasing with the number of adsorbed layers. These results reveal in detail how the surface dynamical properties of a thin film evolve towards those of a thick crystal as a function of increasing dimension. Lattice dynamics calculations, which utilize realistic gas phase pair potentials, reproduce the experimentally observed phonon dispersion relations quite well. We also examine the inelastic scattering probabilities and linewidths of the transitions. GRA

N89-14130# California Univ., Los Angeles. Dept. of Chemistry.
CHEMICAL COMPATIBILITY OF HIGH-Tc SUPERCONDUCTORS WITH OTHER MATERIALS Technical Report No. 12, Aug. 1987 - Jul. 1988
R. S. Williams and S. Chaudhury 22 Jul. 1988 14 p Submitted for publication
(Contract N00014-87-K-0014)
(AD-A199104; AD-E900841) Avail: NTIS HC A03/MF A01 CSCL 07B

In any application, the new oxide superconductors will have to coexist in intimate contact with other materials. However, the copper oxygen bonds common to all presently known oxide superconductors with Tc above 40K are relatively weak. This means that elements that form much stronger bonds with oxygen, such as Si, will be chemically unstable when in contact with the copper-oxide superconductors. In this paper, we will establish procedures and guidelines that will enable workers to choose materials that will not react chemically with the oxide superconductors. These should enable researchers working in all applications areas to avoid unnecessary empirical searches for suitable substrate or host materials by eliminating the most thermodynamically unfavorable choices. In particular, we have determined which of the elemental metals should be most stable in contact with the copper-oxide semiconductors, and examined schemes for integrating these superconductors into Si devices. GRA

N89-14131# California Univ., Los Angeles. Dept. of Physics.
VALENCE-BAND AND CORE-LEVEL PHOTOEMISSION SATELLITES IN NiGa INTERMETALLIC COMPOUND Technical Report No. 13, Aug. 1987 - Jul. 1988
Li-Shing Hsu, R. Stanley Williams, and Duane Outka (Sandia National Labs., Albuquerque, N. Mex.) 22 Jul. 1988 16 p Submitted for publication
(Contract N00014-87-K-0014)
(AD-A199105; AD-E900841) Avail: NTIS HC A03/MF A01 CSCL 07B

Photoemission studies of the valence-band and core-level satellites of NiGa are presented. The valence-band satellite is resonantly enhanced near the 3p threshold (h nu = 67eV), and its centroid position is photon energy dependent, which is in agreement with previous observations for elemental Ni. Surprisingly, the resonantly enhanced valence-band satellite in NiGa has about the same intensity as that for elemental Ni, even though the number of empty d-states contributing to the resonant enhancement is expected to be smaller in NiGa. GRA

N89-14132# Brookhaven National Lab., Upton, N. Y.
ANTIFERROMAGNETISM AND MIXED VALENCY IN YBa2Cu3O(6+x)
John M. Tranquada 1988 17 p Presented at the 18th Rare Earth Research Conference, Lake Geneva, Wisc., 11 Sep. 1988
(Contract DE-AC02-76CH-00016)
(DE88-015201; BNL-41471; CONF-880914-4) Avail: NTIS HC A03/MF A01

Results of some recent neutron diffraction studies of antiferromagnetic ordering and X-ray absorption studies of Cu valence in YBa2Cu3O(6+x) will be reviewed. X-ray absorption measurements at the Cu K-edge demonstrate that when oxygen is removed from a CuO chain, the Cu(2+) ions in that chain are converted to Cu(1+) thus helping to maximize the number of O 2p holes present in the orthorhombic phase, which in turn keeps the superconducting transition temperature high. Neutron diffraction studies have demonstrated that long-range antiferromagnetic ordering occurs throughout the tetragonal phase, predominantly due to Cu(2+) ions in the CuO2 planes. The increasing number of Cu(2+) ions in chain sites with increasing oxygen content causes frustration in interplanar coupling, and eventually a change in spin structure. The recent growth of very large single crystals has made possible inelastic scattering studies of spin waves. DOE

N89-14133# Brookhaven National Lab., Upton, N. Y.
THEORY OF OXYGEN DIFFUSION IN 1,2,3 SUPERCONDUCTING COMPOUNDS
J. P. A. Westerveld, D. M. R. LoCascio, H. Bakker (Amsterdam Univ., Netherlands), and D. O. Welch 1988 10 p Presented at the International Conference on Cryogenic Materials Applications and Properties, Shenyang, People's Republic of China, 7 Jun. 1988
(Contract DE-AC02-76CH-00016)
(DE88-015819; BNL-41544; CONF-880653-3) Avail: NTIS HC A03/MF A01

Results of a theoretical model of the oxygen diffusion in 1,2,3 high-T sub c superconductors (Y Ba sub 2 Cu sub 3 O sub 7-x) are given. DOE

N89-14134# Los Alamos National Lab., N. Mex.
EXCITONIC SUPERCONDUCTIVITY IN COPPER OXIDES
Zlatko Tesanovic, A. R. Bishop, R. L. Martin, and C. Harris (Johns Hopkins Univ., Baltimore, Md.) 1988 12 p Presented at the Adriatico Research Conference: Towards a Theoretical Understanding of High Temperature Superconductors, Trieste, Italy, 26 Jul. 1988
(Contract W-7405-eng-36)
(DE88-016228; LA-UR-88-2549; CONF-880709-1) Avail: NTIS HC A03/MF A01

We discuss the possibility of excitonic superconductivity in high T(sub c) copper oxides. The Hamiltonians describing CuO2 planes supports both antiferromagnetism and low-lying Cu yields O intra- and interband charge fluctuations. One crosses from one regime to another as the number of holes per unit cell increases. The high T(sub c) superconductivity takes place at hole concentrations most favorable for intraband charge transfer excitations. The

dynamic polarizability of the environment surrounding CuO3 planes plays an important role in enhancing T(sub c). DOE

N89-14135# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
EXOTIC NORMAL AND SUPERCONDUCTING PROPERTIES OF HIGH T(SUB c) OXIDES AND SMALL E(SUB f)
V. Z. Kresin, G. Deutscher, and S. A. Wolf May 1988 9 p Presented at the Latin-American Conference on High-Temperature Superconductivity, Rio de Janeiro, Brazil, 5 May 1988
(Contract DE-AC03-76SF-00098)
(DE88-016243; LBL-25483; CONF-880522-2) Avail: NTIS HC A02/MF A01

A key feature of the high T(sub c) oxides is a very small value of the Fermi energy. This feature leads to peculiar thermodynamic and transport properties in the normal and superconductive state. DOE

N89-14136# California Univ., Berkeley. Lawrence Berkeley Lab. Center for Advanced Materials.
CHARACTERIZATION OF As-GROWN AND ANNEALED GaAs: STRUCTURAL DEFECTS AND ELECTRICAL PROPERTIES Ph.D. Thesis
Byung-Teak Lee Jul. 1988 115 p
(Contract DE-AC03-76SF-00098)
(DE88-016669; LBL-25604) Avail: NTIS HC A06/MF A01

Structural defects in GaAs related to excess As were characterized and their behavior upon heat treatments studied. The observed defects included precipitates and dislocations. Results showed most of the precipitates in As-rich GaAs to the rhombohedral arsenic. Two exceptions were observed in an In-doped LEC (liguid encapsulated Czochralski) GaAs, which were As-rich but could not be further identified. Some of the observed As precipitates showed a simple orientation relationship with the matrix which yields structural coherence between As precipitates and GaAs matrix. Other As precipitates showed less coherent orientation. The dislocation loops in As-rich GaAs consisted a faulted loop with Shockley type Burgers vector and a perfect loop associated with an extra (111) plane. It was proposed that these loops were formed as a result of dual condensation of both excess As interstitials and Ga vacancies, followed by generation and movement of Shockley partial dislocations. These precipitates and dislocation loops disappear after annealing, indicating a solvus temperature between 600 to 700 C. The EL2 concentration increased as the defects dissolved, showing the defects to be the source of the excess As required to form EL2. The implication is that the As interstitial and Ga vacancies coexist in GaAs at high temperatures, which indicates that these point defects are responsible for the formation of arsenic antisites by direct combination. During the cooling period, they freeze into the matrix as point defects during a rapid cooling and condense as dislocation loops and precipitates during very slow cooling, in the dislocation-free region of the crystals. Around dislocations, the excess As precipitates heterogeneously even during rapid cooling. DOE

N89-14137# Idaho National Engineering Lab., Idaho Falls.
EDDY CURRENT MEASUREMENTS OF THE NEW HIGH T(SUB c) CERAMIC SUPERCONDUCTORS
K. L. Telschow and D. C. Kunerth 1988 8 p Presented at the Review of Progress in Quantitative Nondestructive Evaluation, La Jolla, Calif., 31 Jul. 1988
(Contract DE-AC07-76ID-01570)
(DE88-016951; EGG-M-88129; CONF-880760-1) Avail: NTIS HC A02/MF A01

The major properties of superconductors are zero resistance and diamagetism (Meissner effect). Eddy current techniques provide a means of determining these properties simultaneously with a noncontacting probe. We present the results of CW measurements obtained for YBa sub 2 Cu sub 3 O sub 7-x prepared by solid state reaction and sol-gel powder fabrication techniques, along with concurrent dc resistive measurements of the transition. The data are interpreted in light of the sample's superconducting properties and the general effects of superconductivity on the eddy current measurement method. DOE

N89-14138# Sandia National Labs., Albuquerque, N. Mex.
RADIATION-HARDENED MICROELECTRONICS FOR ACCELERATORS
James E. Gover and Thomas A. Fischer 1988 6 p Presented at the Nuclear Science Symposium, San Francisco, Calif., 21 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-006869; SAND-87-2609C; CONF-881044-1) Avail: NTIS HC A02/MF A01

Ionization and displacement phenomena in semiconducting materials are reviewed. The different classes of radiation discussed include fast neutron, X-rays and gamma rays and heavy charged particles. Both transient and steady state phenomena will be discussed. How these basic effects lead to change in the electrical characteristics of transistors and diodes and the functionality of intergrated circuits are summarized. The fundamental radiation limits for various semiconductor technologies are summarized. Recommendations and precautions are given regarding the applicability of various microelectronic technologies to different accelerator environments. DOE

N89-14139# Argonne National Lab., Ill. Materials Science Div.
SECONDARY NEUTRAL MASS SPECTROMETRY: THE APPLICATION OF LASER POST IONIZATION TO TRACE SURFACE ANALYSIS IN SEMICONDUCTOR MATERIALS
M. J. Pellin, C. E. Young, W. F. Calaway, J. W. Burnett, and D. M. Gruen 1988 19 p Presented at the Electrochemical Society Fall Meeting, Chicago, Ill., 9 Oct. 1988
(Contract W-31-109-eng-38)
(DE88-012036; CONF-881061-5) Avail: NTIS HC A03/MF A01

Secondary Neutral Mass Spectroscopy (SNMS) uses the secondary neutral sputtered fraction, and can increase both yield and quantitative analysis. In this paper, lasers are used to ionize and then detect the sputtered neutral particles. This method is used with oxygen ion implantation to study Fe on Si substrates. In this way, Fe could be detected at the 500 ppT level in a single monolayer. DOE

N89-14140# Los Alamos National Lab., N. Mex.
ION BEAM ANALYSIS AND MODIFICATION OF THIN FILM HIGH TEMPERATURE SUPERCONDUCTORS
Michael Nastasi 1988 49 p Presented at the NATO Advanced Study Institute on Structure-Property Relationships in Ion-Beam Surface-Modified Ceramics: Theory and Applications, Ciocco, Italy, 28 Aug. 1988
(Contract W-7405-eng-36)
(DE88-016158; LA-UR-88-2795; CONF-8808108-2) Avail: NTIS HC A03

The purpose of the present paper is to show that in addition to modifying materials, ion beams can be used in more gentle but very powerful way to explore what happens to a ceramic thin film as a function processing. The discussions which will follow will be concerned exclusively with the new and exciting class of ceramic, the high temperature superconductor (HTS). We will discuss the application of various ion beam backscattering techniques, as well as examine the use of ion implantation in the processing of these materials. DOE

N89-14141# Los Alamos National Lab., N. Mex. Analysis and Assessment Div.
HIGH TEMPERATURE SUPERCONDUCTORS FOR POWER TRANSMISSION APPLICATION
F. J. Edeskuty, W. F. Stewart, K. D. Williamson, and L. K. Trocki 1988 11 p Presented at the Conference on Electrical Applications of Superconductivity, Orlando, Fla., 21 Sep. 1988 Submitted for publication
(Contract W-7405-eng-36)
(DE88-016232; LA-UR-88-2720; CONF-880937-2) Avail: NTIS HC A03/MF A01

The advent of high temperature superconductors has stimulated interest in their utilization in electric power utility applications. A study of their impact upon power transmission and generation was sponsored by the Electric Power Research Institute. The investigation of the use of a high temperature superconductor in a superconducting power transmission line is reported here. The results of this investigation show that the use of a high temperature superconductor to replace a low temperature superconductor in a superconducting power transmission line results in a significant cost saving. DOE

N89-14142# California Univ., Berkeley. Lawrence Berkeley Lab.

FIRST PRINCIPLES THEORY OF SEMICONDUCTOR SURFACE STATE ENERGIES

Mark S. Hybertsen (Bell Telephone Labs., Inc., Murray Hill, N. J.) and Steven G. Louie Jul. 1988 5 p Presented at the 19th International Conference on the Physics of Semiconductors, Warsaw, Poland, 1 Aug. 1988

(Contract DE-AC03-76SF-00098)

(DE88-016656; LBL-25628; CONF-880884-4) Avail: NTIS HC A02/MF A01

The quasiparticle surface state energies are evaluated for semiconductor surfaces using a self energy approach which incorporates many-body effects due to the electron-electron interaction. Quantitative results are presented for the prototypical Si(111):As and Ge(111):As surfaces and compared to angle resolved photoemission data as well as scanning tunneling spectroscopy measurements showing excellent agreement. Consequences for calculations based on the local density approximation are discussed. DOE

N89-14143# Office of Technology Assessment, Washington, D.C.

COMMERCIALIZING HIGH TEMPERATURE SUPERCONDUCTIVITY

Jun. 1988 172 p

(PB88-246442; OTA-ITE-388; LC-88-600535) Avail: NTIS HC A08/MF A01; also available SOD HC $8.00 as 052-003-01112-3 CSCL 20L

The special report begins with a look at U.S. strengths and weaknesses in technology development and commercialization, both in general and for High Temperature Superconductivity (HTS). The analysis then goes on to the strategies of U.S. and Japanese companies, as managers in each country look ahead to new opportunities. The fourth chapter presents 20 policy options for congressional consideration; the context is U.S. technology policy as a whole, with HTS as a special case. Most of the policy options deal, in one way or another, with the management of the Federal R and D budget. Chapter 5, the last, considers three broad alternatives for speeding commercialization. GRA

N89-14144# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.

SUPERCONDUCTIVITY MECHANISM IN METALLIC OXIDES WITH VARIABLE VALENCE AND ROLE OF SOFTENING EFFECT FOR ELASTICITY MODULE

S. P. Ionov and L. A. Manakova 1987 28 p In RUSSIAN

(DE88-703506; IAE-4462/9) Avail: NTIS (US Sales Only) HC A03/MF A01

Additions to elasticity modules and interatomic distances depending on pair concentration and temperature are shown to occur in crystals with local electron pairs. The mechanism of change in lattice parameters is connected with the account of intercentered correlations and pair transfer to the lattice. The addition values is determined by the first- and second-order derivatives in unperturbed intercentered distance of the Coulomb pair interaction in neighboring nodes and the corresponding overlapping integrals. The feature of lattice parameter dependences on concentration and temperature is the presence of extrema as well as jumpwise change from the disordered state to change-ordered one. DOE

N89-14145# Argonne National Lab., Ill. Materials and Components Technology Div.

SUPERCONDUCTING WIRES

M. T. Lanagan, R. B. Poeppel, J. P. Singh, D. I. DosSantos, J. K. Lumpp, J. T. Dusek, and K. C. Goretta Jun. 1988 14 p Presented at the 18th Rare Earth Research Conference, Lake Geneva, WI, 12-16 Sep. 1988

(Contract W-31-109-eng-38)

(DE89-000623; CONF-880914-5) Avail: NTIS HC A03/MF A01

The requirement of high critical current density has prompted extensive research on ceramic processing of high-T sub c superconductors. An overview of wire fabrication techniques and the limitations they impose on component design will be presented. The effects of processing on microstructure and critical current density will also be discussed. Particle alignment has been observed in extruded samples which is attributed to high shear stresses during plastic forming. Composites of superconductor and silver in several configurations have been made with little deleterious effect on the superconducting properties. DOE

N89-14146# Johns Hopkins Univ., Baltimore, Md. Dept. of Materials Science and Engineering.

ROLE OF SURFACE AND THIN FILM COMPOSITION AND MICROSTRUCTURE AND PROPERTIES OF MATERIALS Final Report, 1 Sep. 1986 - 31 Aug. 1987

Jerome Kruger 6 Jun. 1988 22 p

(Grant AF-AFOSR-0322-86; AF Proj. 2917)

(AD-A197995; AFOSR-88-0899TR) Avail: NTIS HC A03/MF A01 CSCL 11F

This is the Final Report on the Role of Surface and Thin Film Composition and Microstructure and Properties of Materials. After the completion of the renovation of the controlled climate room required for the surface analytical instrumentation in the summer of 1987, the Scanning Auger Microscope (SAM) and the electron spectroscopy for chemical analysis (ESCA) were installed and the new Surface Analytical Laboratory (SAL) containing this equipment became operational in November 1987. GRA

N89-14147# Stanford Univ., Calif. Dept. of Materials Science and Engineering.

CRYSTAL GROWTH AND MECHANICAL PROPERTIES OF SEMICONDUCTOR ALLOYS Annual Report, 15 Apr. 1987 - 14 Apr. 1988

D. A. Stevenson 14 Apr. 1988 25 p

(Grant AF-AFOSR-0158-85; AF Proj. 2306)

(AD-A198153; AFOSR-88-0832TR) Avail: NTIS HC A03/MF A01 CSCL 07B

The mechanical properties of semiconductor materials is a topic of practical and theoretical interest. The mechanical properties relate to the changes in electronic and optical properties that may accompany the processing of semiconductor materials into devices, particularly the introduction of dislocations upon thermal processing, slicing, polishing, ion implantation, and the application of films. GRA

N89-14148# California Univ., Los Angeles. Dept. of Materials Science and Engineering.

REFRACTIVE INDEX MEASUREMENTS OF THE BETA ALUMINAS Technical Report No. 17, Aug. 1987 - Aug. 1988

S. C. Adams, B. Dunn, and O. M. Stafsudd 1 Jul. 1988 17 p

(Contract N00014-83-K-0498)

(AD-A198237) Avail: NTIS HC A03/MF A01 CSCL 07B

The refractive indices of selected monovalent and divalent beta alumina single crystals have been determined using prism refraction techniques. The birefringence was found to vary from uniaxial negative to uniaxial positive depending upon the electronic polarizability of the exchanged ion. Thus, beta' alumina represents a novel material in which the magnitude and polarity of the birefringence can be tuned simply by ion exchange. GRA

N89-14149# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
DEFECT REDUCTION IN EPITAXIAL GROWTH USING SUPERLATTICE BUFFER LAYERS Final Report, 1 Apr. 1985 - 31 Mar. 1988
S. M. Bedair Jul. 1988 69 p
(Grant AF-AFOSR-0201-85; AF Proj. 2306)
(AD-A198409; AFOSR-88-0917TR) Avail: NTIS HC A04/MF A01 CSCL 07B

Superlattice (SL) structures are both fundamental and technical interest. Two classes of superlattices have been investigated. In the first class, the superlattice layers have lattice parameters that closely match those of the substrate, such as in the case of the AlGaAs-GaAs and InP0.53Ga0.47As systems. In the second class, the strained-layer superlattice (SLS) (1), the alternating layers have lattice parameters that are different by a significant amount, but the layers are thin enough that the lattice mismatch is entirely accommodated by elastically straining the layers without the generation of misfit dislocations. GRA

N89-13675*# Massachusetts Inst. of Tech., Cambridge.
PROBES AND MONITORS FOR THE STUDY OF SOLIDIFICATION OF MOLTEN SEMICONDUCTORS
D. R. Sadoway *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 19-25 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 20L

N89-13676*# Massachusetts Inst. of Tech., Cambridge.
FLUID MECHANICS AND MASS TRANSFER IN MELT CRYSTAL GROWTH: ANALYSIS OF THE FLOATING ZONE AND VERTICAL BRIDGMAN PROCESSES
R. A. Brown *In its* The materials processing research base of the Materials Processing Center 30 Sep. 1986 p 27-48 (For primary document see N89-13671 05-29)
Avail: NTIS HC A04/MF A01 CSCL 20L

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N89-14150# Academy of Sciences of the Ukrainian SSR, Kiev. Inst. Teoreticheskoj Fiziki.
CONFORMALLY COVARIANT OPERATORS AND EFFECTIVE ACTION IN EXTERNAL GRAVITATIONAL FIELD
V. P. Gusynin and V. V. Romankov 1986 15 p In RUSSIAN; ENGLISH summary
(DE88-702895; ITF-86-126) Avail: NTIS (US Sales Only) HC A03/MF A01

The n-dimensional expresions for the second order conformally covariant differential operators acting on vector and tensor fields and for the fourth order conformally covariant operator acting on scalar fields are obtained. For the fourth order operator one-loop effective action is evaluated in four dimensions. The possibility of effective action evaluation for other conformally covariant operators is discussed. DOE

N89-14151# Boeing Aerospace Co., Seattle, Wash. Electronics Dept.
NONEQUILIBRIUM PHASE TRANSITIONS, APPENDIX A-F Final Report, 1 Oct. 1984 - 30 Sep. 1988
Paul H. Lindenmeyer 20 Sep. 1988 67 p
(Contract DAAG29-84-C-0022)
(AD-A198707; ARO-21402.1-MS) Avail: NTIS HC A04/MF A01 CSCL 20M

A novel approach to a nonlinear nonequilibrium thermodynamics has been developed which predicts that the morphological structure and consequently the physical properties of polymeric materials might be controlled by dynamically fluctuating the external thermodynamic and/or pseudo-thermodynamic variables; measuring the response of the system to such fluctuations; and using this information to control the time evolution of the thermodynamic system. The theoretical development suggests replacing the concept of entropy with the concept of an excess energy. The excess energy of a nonequilibrium system-defined mathematically as the total Legendre transform of energy with respect to an independent set of extensive properties-plays the same role in nonequilibrium thermodynamics as do the free energy functions (i.e., partial Legendre transforms) in equilibrium thermodynamics. The partial Legendre transforms are functions of the (average) thermodynamic parameters whereas the total Legendre transform or excess energy is a functional or integral over both time and space of the gradients and the time rate of change of the thermodynamic and pseudo-thermodynamic parameters. At equilibrium there is no significant fluctuation about the average value of a thermodynamic parameter in either time or space so that the excess energy vanishes. GRA

N89-14152# Academy of Sciences of the Armenian SSR, Erivan.
LAGRANGIAN OF SIX-DIMENSIONAL CHIRAL ANOMALOUS SUPERGRAVITIES
A. R. Kavalov and R. L. Mkrtchyan 1987 13 p In RUSSIAN; ENGLISH summary
(DE88-703816; EFI-963(13)-87) Avail: NTIS (US Sales Only) HC A03/MF A01

The Lagrangian of the minimal six-dimensional anomalous N=2 and N=4b supergravities are constructed which have all symmetries of these theories, in particular, explicit Lorentz-invariance and supersymmetry. They also have an additional local alpha -symmetry acting nontrivially only off the mass shell. Owing to this symmetry, the commutator of two super-symmetry transformations is closed on all boson fields without equations of motion. Other symmetry commutators of the theory are also calculated (alpha -symmetry and supersymmetry). The obtained Lagrangians are basic for the construction of those for six-dimensional chiral nonanomalous supergravities. DOE

N89-14153# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ON A PERMISSIBLE ANISOTROPY OF SPACE-TIME
V. N. Streltsov 1987 10 p In RUSSIAN
(DE88-703729; JINR-R-2-87-643) Avail: NTIS (US Sales Only) HC A02/MF A01

Conventional character of the concept of simultaneity and distance in a special relativity theory is discussed. Lorentz-Edwards transformations are considered taking into account explicity allowable time anisotropy. Permissible experimentally space anisotropy is introduced by the gauge transformation of space coordinate in the Lorentz formulae. Finally a possibility of introduction of anisotropic space-time within the stated conventions is considered. Corresponding generalized Lorentz transformations, expressions for one-way velocities, right and left distances for material bodies etc., are obtained. The possibility to generalize the Lobachevsky geometry over anisotropic space of velocities is also discussed. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N89-14154*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM: 1988 RESEARCH REPORTS
Loren A. Anderson, ed. (University of Central Florida, Orlando.) and Dennis W. Armstrong, ed. Oct. 1988 562 p Program held in Cocoa Beach, Fla., 1 Jun. - 7 Aug. 1988; sponsored by NASA, Washington, D.C. and ASEE

(Grant NGT-60002)
(NASA-CR-183406; NAS 1.26:183406) Avail: NTIS HC A24/MF A01 CSCL 05I

This contractor's report contains all sixteen final reports prepared by the participants in the 1988 Summer Faculty Fellowship Program. Reports describe research projects on a number of topics including controlled environments, robotics, cryogenic propellant storage, polymers, hydroponic culture, adaptive servocontrol, and computer aided design For individual titles, see N89-14155 through N89-14170.

N89-14155*# North Carolina State Univ., Raleigh. Dept. of Botany.

GASEOUS EMISSIONS FROM PLANTS IN CONTROLLED ENVIRONMENTS c51

Denis T. DuBay *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 1-18 (SEE N89-14154 05-80)

Avail: NTIS HC A24/MF A01 CSCL 06C

Plant growth in a controlled ecological life support system may entail the build-up over extended time periods of phytotoxic concentrations of volatile organic compounds produced by the plants themselves. Ethylene is a prominent gaseous emission of plants, and is the focus of this report. The objective was to determine the rate of ethylene release by spring wheat, white potato, and lettuce during early, middle, and late growth stages, and during both the light and dark segments of the diurnal cycle. Plants grown hydroponically using the nutrient film technique were covered with plexiglass containers for 4 to 6 h. At intervals after enclosure, gas samples were withdrawn with a syringe and analyzed for ethylene with a gas chromatograph. Lettuce produced 10 to 100 times more ethylene than wheat or potato, with production rates ranging from 141 to 158 ng g-dry/wt/h. Wheat produced from 1.7 to 14.3 ng g-dry/wt/h, with senescent wheat producing the least amount and flowering wheat the most. Potatoes produced the least amount of ethylene, with values never exceeding 5 ng g-dry/wt/h. Lettuce and potatoes each produced ethylene at similar rates whether in dark period or light period. Ethylene sequestering of 33 to 43 percent by the plexiglass enclosures indicated that these production estimates may be low by one-third to one-half. These results suggest that concern for ethylene build-up in a contained atmosphere should be greatest when growing lettuce, and less when growing wheat or potato. Author

N89-14156*# Iowa State Univ. of Science and Technology, Ames.

THREE DEGREE-OF-FREEDOM FORCE FEEDBACK CONTROL FOR ROBOTIC MATING OF UMBILICAL LINES c37

R. Rees Fullmer *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 19-41 (SEE N89-14154 05-80)

Avail: NTIS HC A24/MF A01 CSCL 13I

The use of robotic manipulators for the mating and demating of umbilical fuel lines to the Space Shuttle Vehicle prior to launch is investigated. Force feedback control is necessary to minimize the contact forces which develop during mating. The objective is to develop and demonstrate a working robotic force control system. Initial experimental force control tests with an ASEA IRB-90 industrial robot using the system's Adaptive Control capabilities indicated that control stability would by a primary problem. An investigation of the ASEA system showed a 0.280 second software delay between force input commands and the output of command voltages to the servo system. This computational delay was identified as the primary cause of the instability. Tests on a second path into the ASEA's control computer using the MicroVax II supervisory computer show that time delay would be comparable, offering no stability improvement. An alternative approach was developed where the digital control system of the robot was disconnected and an analog electronic force controller was used to control the robot's servosystem directly, allowing the robot to use force feedback control while in rigid contact with a moving three-degree-of-freedom target. An alternative approach was developed where the digital control system of the robot was disconnected and an analog electronic force controller was used to control the robot's servo system directly. This method allowed the robot to use force feedback control while in rigid contact with moving three degree-of-freedom target. Tests on this approach indicated adequate force feedback control even under worst case conditions. A strategy to digitally-controlled vision system was developed. This requires switching between the digital controller when using vision control and the analog controller when using force control, depending on whether or not the mating plates are in contact. Author

N89-14157*# North Carolina State Univ., Raleigh. Dept. of Civil and Mechanical Engineering.

SHOCK SPECTRA APPLICATIONS TO A CLASS OF MULTIPLE DEGREE-OF-FREEDOM STRUCTURES SYSTEM c39

Shoi Y. Hwang *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 42-77 (SEE N89-14154 05-80)

Avail: NTIS HC A24/MF A01 CSCL 20K

The demand on safety performance of launching structure and equipment system from impulsive excitations necessitates a study which predicts the maximum response of the system as well as the maximum stresses in the system. A method to extract higher modes and frequencies for a class of multiple degree-of-freedom (MDOF) Structure system is proposed. And, along with the shock spectra derived from a linear oscillator model, a procedure to obtain upper bound solutions for maximum displacement and maximum stresses in the MDOF system is presented. Author

N89-14158*# Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.

STUDIES OF CRYOGENIC PROPELLANT STORAGE AND HANDLING FOR THE LUNAR LANDING AND LAUNCH FACILITY (COMPLEX 39L) c28

Jerald N. Linsley *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 78-117 (SEE N89-14154 05-80)

Avail: NTIS HC A24/MF A01 CSCL 21I

A brief description of Complex 39L as it is currently conceived is presented. A brief discussion of lunar thermal history is then presented. From this follows a discussion of the current lunar thermal environment which will impact the design of cryogenic storage and handling facilities on the moon. Some previous studies are discussed. A conceptual design of liquid oxygen and hydrogen storage facilities is presented. The essential feature of this facility is that cryogens are to be stored in a number of small tanks which can serve as lander propellant tanks rather than as one large storage vessel. These tanks will be placed under a Fuel Inventory Tent (FIT) for shadow shielding. Methods of dealing with propellant boil-off are discussed. A base case cascade refrigeration system for requirements are such that it seems very feasible to construct a prototype boil-off recovery system in a laboratory environment. Author

N89-14159*# University of Central Florida, Orlando. Dept. of Chemistry.

THE SYNTHESIS OF CONDUCTING POLYMERS FOR CORROSION PREVENTION c27

Guy C. Mattson *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 118-129 (SEE N89-14154 05-80)

Avail: NTIS HC A24/MF A01 CSCL 11C

The formation of an electrically conducting form of polyaniline

by the oxidative polymerization of aniline was studied. Optimum yield and conductivities were obtained by treating aniline in 2 molar hydrochloric acid at 0 to 5 C with ammonium persulfate in 1.15 mole ratio. The yield was 37.6 percent of theory and the conductivity of the product was 10.5 S/cm. This material was formulated into epoxy and acrylic coatings which were also electrically conductive. Author

N89-14160*# Puerto Rico Univ., San Juan. Coll. of Engineering.
CHARACTERIZATION OF A TURBOMOLECULAR-PUMPED MAGNETIC SECTOR MASS SPECTROMETER c35
Narinder K. Mehta *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 130-178 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 14B

A Perkin Elmer MGA-1200, turbomolecular-pumped, magnetic sector, multiple gas analyzer mass spectrometer with modified inlet for fast response was characterized for the analysis of hydrogen, helium, oxygen and argon in nitrogen and helium background gases. This instrument was specially modified for the Vanderberg AFB SLC-6 Hydrogen Disposal Test Program, as a part of the Hydrogen Sampling System (H2S2). Linearity, precision, drift, detection limits and accuracy among other analytical parameters for each of the background gas were studied to evaluate the performance of the instrument. The result demonstrates that H2S2 mass spectrometer is a stable instrument and can be utilized for the quantitative analytical determination of hydrogen, helium, oxygen and argon in nitrogen and helium background gases. Author

N89-14161*# California State Polytechnic Univ., Pomona. Dept. of Chemical and Materials Engineering.
EVALUATION OF CANDIDATE ALLOYS FOR THE CONSTRUCTION OF METAL FLEX HOSES IN THE STS LAUNCH ENVIRONMENT c26
Cordelia Ontiveros *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 179-206 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 11F

Various vacuum jacketed cryogenic supply lines at the Shuttle launch site use convoluted flexible expansion joints. The atmosphere at the launch site has a very high salt content, and during a launch, fuel combustion products include hydrochloric acid. This extremely corrosive environment has caused pitting corrosion failure in the flex hoses, which were made of 304L stainless steel. A search was done to find a more corrosion resistant replacement material. This study focused on 19 metal alloys. Tests which were performed include electrochemical corrosion testing, accelerated corrosion testing in a salt fog chamber, long term exposure at the beach corrosion testing site, and pitting corrosion tests in ferric chloride solution. Based on the results of these tests, the most corrosion resistant alloys were found to be (in order) Hastelloy C-22, Inconel 625, Hastelloy C-276, Hastelloy C-4, and Inco Alloy G-3. Of these top five alloys, the Hastelloy C-22 stands out as being the best of those tested for this application. Author

N89-14162*# Florida Inst. of Tech., Melbourne. Dept. of Aerospace and Mechanical Engineering.
ON THE HAZARD OF HYDROGEN EXPLOSIONS AT SPACE SHUTTLE LAUNCH PADS c28
John M. Russell *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 207-250 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 21I

This report was prepared in support of efforts to assess the hazard of accidental explosions of unburned hydrogen at space shuttle launch pads. It begins with presentation of fundamental detonation theory and a review of relevent experiments. A scenario for a catastrophic explosion at a KSC launch pad and a list of necessary conditions contributing to it is proposed with a view to identifying those conditions which, if blocked, would prevent a catastrophe. The balance of the report is devoted to juxtaposition of reassuring and disquieting facts, presentation of a set of recommendations that ignition of hydrogen-air mixtures by weak ignition sources in unconfined geometries may produce a detonation, provided the effective flame area in the initial fireball is rapidly increased by turbulent mixing. Another conclusion is that detonability limits can be different from and narrower than flammability limits only if one restricts the rate of work that can be done on a flammable gas by mechanical agencies acting on its boundaries. Author

N89-14163*# Puerto Rico Univ., San Juan. Dept. of Electrical Computer Engineering.
MEASUREMENTS OF INDUCED VOLTAGES AND CURRENTS IN A DISTRIBUTION POWER LINE AND ASSOCIATED ATMOSPHERIC PARAMETERS c33
Julio Santiago-Perez *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 251-310 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 09C

The frequency and intensity of thunderstorms around the Kennedy Space Center (KSC) has affected scheduled launch, landing, and other ground operations for many years. In order to protect against and provide safe working facilities, KSC has performed and hosted several studies on lightning phenomena. For the reasons mentioned above, KSC has established the Atmospheric Science Field Laboratory (ASFL). At these facilities KSC launches wire-towing rockets into thunderstorms to trigger natural lightning to the launch site. A program named Rocket Triggered Lightning Program (RTLP) is being conducted at the ASFL. This report calls for two of the experiments conducted in the summer 1988 Rocket Triggered Lightning Program. One experiment suspended an electric field mill over the launching areas from a balloon about 500 meters high to measure the space charges over the launching area. The other was to connect a waveform recorder to a nearby distribution power line to record currents and voltages wave forms induced by natural and triggered lightning. Author

N89-14164*# Florida Inst. of Tech., Melbourne. Dept. of Computer Science.
THE DESIGN OF AN INTELLIGENT HUMAN-COMPUTER INTERFACE FOR THE TEST, CONTROL AND MONITOR SYSTEM c54
William D. Shoaff *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 311-383 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 05H

The graphical intelligence and assistance capabilities of a human-computer interface for the Test, Control, and Monitor System at Kennedy Space Center are explored. The report focuses on how a particular commercial off-the-shelf graphical software package, Data Views, can be used to produce tools that build widgets such as menus, text panels, graphs, icons, windows, and ultimately complete interfaces for monitoring data from an application; controlling an application by providing input data to it; and testing an application by both monitoring and controlling it. A complete set of tools for building interfaces is described in a manual for the TCMS toolkit. Simple tools create primitive widgets such as lines, rectangles and text strings. Intermediate level tools create pictographs from primitive widgets, and connect processes to either text strings or pictographs. Other tools create input objects; Data Views supports output objects directly, thus output objects

are not considered. Finally, a set of utilities for executing, monitoring use, editing, and displaying the content of interfaces is included in the toolkit. Author

N89-14165*# South Carolina Univ., Columbia. Dept. of Physics.
ELECTROSTATIC TESTING OF THIN PLASTIC MATERIALS **c27**
S. Ballou Skinner *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 384-411 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 11C

Ten thin plastic materials (Velostat, RCAS 1200, Llumalloy, Herculite 80, RCAS 2400, Wrightlon 7000, PVC, Aclar 22A, Mylar, and Polyethylene) were tested for electrostatic properties by four different devices: (1) The static decay meter, (2) the manual triboelectric testing device, (3) the robotic triboelectric testing device, and (4) the resistivity measurement adapter device. The static decay meter measured the electrostatic decay rates in accordance with the Federal Test Method Standard 101B, Method 4046. The manual and the robotic triboelectric devices measured the triboelectric generated peak voltages and the five-second decay voltages in accordance with the criteria for acceptance standards at Kennedy Space Center. The resistivity measurement adapter measured the surface resistivity of each material. An analysis was made to correlate the data among the four testing devices. For the material tested the pass/fail results were compared for the 4046 method and the triboelectric testing devices. For the limited number of materials tested, the relationship between decay rate and surface resistivity was investigated as well as the relationship between triboelectric peak voltage and surface resistivity. Author

N89-14166*# North Carolina Univ., Charlotte. Dept. of Engineering Technology.
LABORATORY TESTING OF A SUPERCRITICAL HELIUM PUMP FOR A MAGNETIC REFRIGERATOR **c31**
Pao-lien Wang *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 412-439 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 13B

A supercritical helium testing system for a magnetic refrigerator has been built. Details of the supercritical helium pump, the test system, and the test instrumentation are given. Actual pump tests were not run during this ASEE term because of delivery problems associated with the required pump flow meter. Consequently, efforts were directed on preliminary design of the magnetic refrigeration system for the pump. The first concern with the magnetic refrigerator design was determining how to effectively make use of the pump. A method to incorporate the supercritical helium pump into a magnetic refrigerator was determined by using a computer model. An illustrated example of this procedure is given to provide a tool for sizing the magnetic refrigerator system as a function of the pump size. The function of the computer model and its operation are also outlined and discussed. Author

N89-14167*# Connecticut Univ., Storrs. Dept. of Molecular and Cell Biology.
HORMONAL REGULATION OF WHEAT GROWTH DURING HYDROPONIC CULTURE **c51**
Donald Wetherell *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 440-454 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 06C

Hormonal control of root growth has been explored as one means to alleviate the crowding of plant root systems experienced in prototype hydroponic biomass production chambers being developed by the CELSS Breadboard Project. Four plant hormones, or their chemical analogs, which have been reported to selectively inhibit root growth, were tested by adding them to the nutrient solutions on day 10 of a 25 day growth test using spring wheat in hydroponic cultures. Growth and morphological changes is both shoot and root systems were evaluated. In no case was it possible to inhibit root growth without a comparable inhibition of shoot growth. It was concluded that this approach is unlikely to prove useful for wheat. Author

N89-14168*# University of Central Florida, Orlando.
TRANSMISSION OF MULTIPLEXED VIDEO SIGNALS IN MULTIMODE OPTICAL FIBER SYSTEMS **c32**
Preston White, III *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 455-485 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 17B

Kennedy Space Center has the need for economical transmission of two multiplexed video signals along multimode fiberoptic systems. These systems must span unusual distances and must meet RS-250B short-haul standards after reception. Bandwidth is a major problem and studies of the installed fibers, available LEDs and PINFETs led to the choice of 100 MHz as the upper limit for the system bandwidth. Optical multiplexing and digital transmission were deemed inappropriate. Three electrical multiplexing schemes were chosen for further study. Each of the multiplexing schemes included an FM stage to help meet the stringent S/N specification. Both FM and AM frequency division multiplexing methods were investigated theoretically and these results were validated with laboratory tests. The novel application of quadrature amplitude multiplexing was also considered. Frequency division multiplexing of two wideband FM video signal appears the most promising scheme although this application requires high power highly linear LED transmitters. Futher studies are necessary to determine if LEDs of appropriate quality exist and to better quantify performance of QAM in this application. Author

N89-14169*# Oregon Inst. of Tech., Klamath Falls. Dept. of Electronics.
ADAPTIVE SERVO CONTROL FOR UMBILICAL MATING **c37**
Omar Zia *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research Oct. 1988 Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 487-519 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 13I

Robotic applications at Kennedy Space Center are unique and in many cases require the fime positioning of heavy loads in dynamic environments. Performing such operations is beyond the capabilities of an off-the-shelf industrial robot. Therefore Robotics Applications Development Laboratory at Kennedy Space Center has put together an integrated system that coordinates state of the art robotic system providing an excellent easy to use testbed for NASA sensor integration experiments. This paper reviews the ways of improving the dynamic response of the robot operating under force feedback with varying dynamic internal perturbations in order to provide continuous stable operations under variable load conditions. The goal is to improve the stability of the system with force feedback using the adaptive control feature of existing system over a wide range of random motions. The effect of load variations on the dynamics and the transfer function (order or values of the parameters) of the system has been investigated, more accurate models of the system have been determined and analyzed. Author

N89-14170*# Missouri Univ., Rolla. Dept. of Computer Science.
PERFORMANCE EVALUATION OF NASA/KSC CAD/CAE GRAPHICS LOCAL AREA NETWORK **c61**
George Zobrist *In* NASA, John F. Kennedy Space Center, NASA/ASEE Summer Faculty Fellowship Program: 1988 Research

Oct. 1988 · Reports p (For primary document see Summer Faculty Fellowship Program: 1988 Research Reports p 520-557 (SEE N89-14154 05-80)
Avail: NTIS HC A24/MF A01 CSCL 09B

This study had as an objective the performance evaluation of the existing CAD/CAE graphics network at NASA/KSC. This evaluation will also aid in projecting planned expansions, such as the Space Station project on the existing CAD/CAE network. The objectives were achieved by collecting packet traffic on the various integrated sub-networks. This included items, such as total number of packets on the various subnetworks, source/destination of packets, percent utilization of network capacity, peak traffic rates, and packet size distribution. The NASA/KSC LAN was stressed to determine the useable bandwidth of the Ethernet network and an average design station workload was used to project the increased traffic on the existing network and the planned T1 link. This performance evaluation of the network will aid the NASA/KSC network managers in planning for the integration of future workload requirements into the existing network. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N89-14171# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
COMPUTER AIDED PETRI NET DESIGN FOR DECISION-MAKING ORGANIZATIONS
I. M. Kyratzoglou and Alexander H. Levis Aug. 1988 10 p
(Contract N00014-85-K-0782)
(AD-A198987; LIDS-P-1806) Avail: NTIS HC A02/MF A01 CSCL 12E

A Computer Aided Petri Net Design System is developed for creating decision-making organizational architectures of arbitrary complexity and for computing the structural attributes describing the organization. The Design System has four modes of operation: a Graphics Editor mode, used for the interactive generation of the Petri Net Structure of the organization: a text Editor Mode, used to store, modify and retrieve attributes assigned to the Petri Net primitives: a Structural Analysis mode, used to generate the structural properties of the organization, such as the incidence matrix, the interconnection matrix and the information flow paths; and a Hardcopy mode, used to generate graphic images on output devices. In addition, a set of auxiliary functions handle the file manipulation, user-software interface, command interpretation and grammar-rule enforcing tasks of the Systems. GRA

N89-14172*# National Aeronautics and Space Administration, Washington, D.C.
THE 1989 LONG-RANGE PROGRAM PLAN
19 Dec. 1988 229 p
Avail: NTIS HC A11/MF A01 CSCL 05A

The President's National Space Policy of 1988 reaffirms that space activities serve a variety of vital national goals and objectives, including the strengthening of U.S. scientific, technological, political, economic, and international leadership. The new policy stresses that civil space activities contribute significantly to enhancing America's world leadership. Goals and objectives must be defined and redefined, and each advance toward a given objective must be viewed as a potential building block for future programs. This important evolutionary process for research and development is reflected, describing NASA's program planning for FY89 and later years. This plan outlines the direction of NASA's future activities by discussing goals, objectives, current programs, and plans for the future. The 1989 plan is consistent with national policy for both space and aeronautics, and with the FY89 budget that the President submitted to Congress in February 1988. Author

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N89-14173 Texas Univ., Austin.
KNOWLEDGE BASED AIDS FOR MODEL CONSTRUCTION Ph.D. Thesis
Ramayya Krishnan 1987 246 p
Avail: Univ. Microfilms Order No. DA8806361

Recent years have seen the emergence of improved computer-based support for mathematical modeling. However, these systems do not support the transition from the requirements specifications to the model construction phase of the modeling life cycle and require skills that most users of decision support systems do not possess. This research proposes a knowledge-based architecture for constructing models in a dynamic and flexible manner and implements it to support the construction of linear programming models of production, distribution and inventory planning problems. This has involved the design of a declarative problem specification language based on first order logic, formulation and representation of transformations based on domain-independent modeling principles and the introduction of an object-oriented scheme to represent knowledge used to construct and generate executable specifications of algebraic equations. The proposed architecture applies concepts hitherto unused in dynmaic modeling construction. The specification of the problem in the first-order language yields a logic model which, in addition to serving as input to the model construction process, is used to support structural revision of the problem description and to infer qualitative problem details. Supplementing model construction through features to support model evolution and the deduction of problem details adds an important dimension in light of the increased need for integrated decision support.
Dissert. Abstr.

N89-14174# Systems Research Labs., Inc., Dayton, Ohio.
USER'S GUIDE TO ACCESSING THE ANTHROPOMETRIC DATA BASE AT THE CENTER FOR ANTHROPOMETRIC RESEARCH DATA Interim Report, Feb. 1987 - Jan. 1988
Joyce C. Robinson, Kathleen M. Robinette, and Gregory F. Zehner Jan. 1988 60 p
(AD-A198771; AAMRL-TR-88-012) Avail: NTIS HC A04/MF A01 CSCL 23B

This document is provided to assist users in accessing the Anthropometric Data Base maintained by the Center for Anthropometric Research Data. The on-line data base was developed to be used in support of human engineering design activities. It contains several hundred measurements of the human body across large population samples from numerous published anthropometric surveys. A relational data base software package is used to manage the survey data and accommodate user queries. Access to the data base is through a menu-driven applications software package. The user may access anthropometric data by measurement title, measurement number, or by common alternate measurement name. Available data includes measurement frequency data and summary statistics (mean, standard deviation, etc.), measurement descriptions, and measurement classification by body region and measurement type. A glossary of anthropometric terms is available in the data base as well as abstracts for the various anthropometric surveys. GRA

N89-14175# Virginia Univ., Charlottesville. Dept. of Computer Science.
THE StarLite PROJECT Annual Progress Report, 1 Sep. 1987 - 1 Oct. 1988
R. P. Cook and Sang H. Son Sep. 1988 57 p
(Contract N00014-86-K-0245)

(AD-A198858; UVA/525410/CS89/102) Avail: NTIS HC A04/MF A01 CSCL 12E

The StarLite Project has the goal of constructing a program library for real-time applications. The initial focus of the project is on operating system and database support. The project also involves the construction of a prototyping environment that supports experimentation with concurrent and distributed algorithms in a host environment before down-loading to a target system for performance testing. The components of the project include a Modula-2 compiler, a symbolic Modula-2 debugger, an interpreter/runtime, package, the Phoenix operating system, the meta-file system, a visual simulation package, a database system, and documentation. GRA

N89-14176# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Computer Science.

DESIGN AND IMPLEMENTATION OF A CONTROLLER AND A HOST SIMULATOR FOR A RELATIONAL REPLICATED DATABASE SYSTEM M.S. Thesis

Leonard A. Lyon 1987 174 p

(AD-A198951; AFIT/CI/NR-88-61) Avail: NTIS HC A08/MF A01 CSCL 12E

Database machines and parallel database systems are becoming a viable alternative for handling transactions on voluminous databases especially with the declining cost of hardware. Database research has spawned a variety of parallel processing architectures to improve the performance of database machines. However, many of these architectures are based upon unique hardware configurations and technologies including processor-per-track, processor-per-head, and off-the-disk designs. Alternative backend database system which will be utilized for processing transactions on voluminous databases. The complete performance analysis and design of RRDS is currently being carried out by a Ph.D. student at the University of Central Florida. RRDS supports the relational data model and consists of multiple processors running replicated copies of the database management system (DBMS) software on a partitioned database. The general hardware organization is composed of a controller and a collection of replicated computers which can be implemented as microcomputers or minicomputers. GRA

N89-14177# Idaho National Engineering Lab., Idaho Falls. Systems Architecture.

INFORMATION RESOURCE MANAGEMENT: AN ARCHITECTURAL CONCEPT/EXPERIENCE

M. Kent Linsenmann 1988 20 p Presented at the International Software AG Users Group, Nashville, Tenn., 25 Sep. 1988

(Contract DE-AC07-76ID-01570)

(DE88-015184; EGG-M-88216; CONF-8809112-1) Avail: NTIS HC A03/MF A01

This paper contains an integrated Database System strategy utilizing a System Architecture concept comprised of the following components: Data Integration (Data Administration and Database Administration); Single-System change (Application Architecture); and Business System Integration. DOE

N89-13918# Pacific Northwest Labs., Richland, Wash.

EXPERIENCES WITH A DATA ANALYSIS MANAGEMENT PROTOTYPE

Paula J. Cowley, Daniel B. Carr, and Wesley L. Nicholson *In* Colorado State Univ., Computer Science and Statistics. Proceedings of the 18th Symposium on the Interface 26 Aug. 1987 p 147-150 Previously announced as N87-11626 (For primary document see N89-13901 05-60)

Avail: NTIS HC A20/MF A01 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N89-14178# Committee on Science, Space and Technology (U.S. House).

THE 1989 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION, VOLUME 1

1988 133 p Hearings before the Subcommittee on Transportation, Aviation and Materials of the Committee on Science, Space and Technology, 100th Congress, 2d Session, No. 94, 12-13 Apr. 1988

(GPO-86-166) Avail: Subcommittee on Transportation, Aviation and Materials of the Committee on Science, Space and Technology, House of Representatives, Washington, D.C. 20515 HC free

A congressional report of authorization hearings before the Subcommittee on Transportation, Aviation and Materials of the Committee on Science, Space, and Technology of the House of Representatives of the 100th Congress is presented. The subcommittee considers NASA fiscal year 1989 budget request for aeronautics. Two particular items of interest are the budgets for Aeronautical Research and Technology and the Transatmospheric Research and Technology, the latter item also known as the Aerospace Plane. E.R.

N89-14179# Committee on Science, Space and Technology (U.S. House).

THE COMMERCIAL SPACE LAUNCH ACT AMENDMENTS

1988 365 p Hearings on H.R. 3765 before the Subcommittee on Space Science and Applications of the Committee on Science, Space and Technology, 100th Congress, 2d Session, No. 114, 16-17 Feb. 1988

(GPO-84-644) Avail: Subcommittee on Space Science and Applications, House of Representatives, Washington, D.C. 20515 HC free; SOD SN-552-070-048-81-2 HC $11.00

This congressional report of the hearings before the Subcommittee on Space Science and Applications of the Committee on Science, Space, and Technology of the U.S. House of Representatives of the 100th Congress, concerns itself with H.R. 3765, the Commercial Space Launch Act Amendments. The progress made toward developing a truly commercial launch industry is discussed. E.R.

N89-14180# Committee on Commerce, Science, and Transportation (U.S. Senate).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION, PART 3

1988 148 p Hearing before the Subcommittee on Science, Technology and Space of the Committee on Commerce, Science and Transportation, 100th Congress, 2d Session, 22 Mar. 1988

(S-Hrg-100-579-Pt-3; GPO-87-269) Avail: Subcommittee on Science, Technology and Space of the Committee on Commerce, Science and Transportation, Senate, Washington, D.C. 20510 HC free; SOD SN-552-070-045-89-9 HC $4.25

Funding for the restoration of the space shuttle to safe flight; the National Space Policy; and the NASA budget are discussed. B.G.

N89-14181# Committee on Science, Space and Technology (U.S. House).
THE 1989 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION, VOLUME 2
1988 1133 p Hearings before the Subcommittee on Space Science and Applications of the Committee on Science, Space and Technology, 100th Congress, 2d Session, 3; 8-10; 22-24; 29-31 Mar. 1988
(GPO-86-904) Avail: Subcommittee on Space Science and Applications of the Committee on Science, Space and Technology, House of Representatives, Washington, D.C. 20515 HC free; SOD SN-552-070-050-23-0 HC $29.00

Funding for the restoration of the space shuttles to eliminate payload backlog; restoration of the U.S. leadership in space; the space station; and continuity and advances in space science, aeronautics and space technology is discussed. B.G.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N89-14182*# Stirling Technology Co., Richland, Wash.
THE 25 kWe SOLAR THERMAL STIRLING HYDRAULIC ENGINE SYSTEM: CONCEPTUAL DESIGN Final Report
Maurice White, Grant Emigh, Jack Noble, Peter Riggle, and Torvald Sorenson Jan. 1988 242 p
(Contracts DEN3-371; DE-AT04-85AL-33408)
(NASA-CR-180889; DOE/NASA/0371-1; NAS 1.26:180889; Rept-8803) Avail: NTIS HC A11/MF A01 CSCL 10B

The conceptual design and analysis of a solar thermal free-piston Stirling hydraulic engine system designed to deliver 25 kWe when coupled to a 11 meter test bed concentrator is documented. A manufacturing cost assessment for 10,000 units per year was made. The design meets all program objectives including a 60,000 hr design life, dynamic balancing, fully automated control, more than 33.3 percent overall system efficiency, properly conditioned power, maximum utilization of annualized insolation, and projected production costs. The system incorporates a simple, rugged, reliable pool boiler reflux heat pipe to transfer heat from the solar receiver to the Stirling engine. The free-piston engine produces high pressure hydraulic flow which powers a commercial hydraulic motor that, in turn, drives a commercial rotary induction generator. The Stirling hydraulic engine uses hermetic bellows seals to separate helium working gas from hydraulic fluid which provides hydrodynamic lubrication to all moving parts. Maximum utilization of highly refined, field proven commercial components for electric power generation minimizes development cost and risk. Author

N89-14183# Universal Energy Systems, Inc., Dayton, Ohio.
AIR FORCE RESEARCH INITIATION PROGRAM, VOLUME 1 Interim Technical Report, 1986
Rodney C. Darrah Apr. 1988 691 p
(Contract F49620-85-C-0013)
(AD-A198820; AFOSR-88-0720TR-Vol-1) Avail: NTIS HC A99/MF A02 CSCL 05B

Mini-grant research reports of the Air Force 1986 Research Initiation Program in vol. 1 include: Weather forecast evaluation by decomposition of the wind field into barotropic and baroclinic components; An EPR study of the role of catalysts in the thermal decomposition of nitroaromatic compounds; Stellar scintillometer based studies of optical turbulence; Impact of cognitive styles on decision making; Feasibility study and test application of uncertainty estimates to an atmospheric dispersion model with potential utility in AF operations; Design of multivariable optimal control systems; Visualization of hydrocarbon jet diffusion flames; Infrared fluorescence and photoacoustic measurements and NO (v=2) relaxation as a function of temperature; Heat and mass transfer in a dual-latent heat packed bed thermal storage system; Long-term potentiation in interneurons in the mammalian brain; Development of image processing algorithms for AFGL ultraviolet camera and other imaging systems; Relationship between stages of motor learning and kinesthetic sensitivity; Investigation of pulsed discharges in nitrogen for plasma processing; Modeling of failure mechanisms in ceramic composites under flexural loading; Sensitivity of mesoscale wind to variations in vegetation canopy parameters and surface properties; Effects of exercise and dobutamine on suspension hypokinesia/hypodynamia deconditioning in rats; Computer communications using knowledge based systems; and Droplet size distribution measurement. GRA

N89-14184# Universal Energy Systems, Inc., Dayton, Ohio.
AIR FORCE RESEARCH INITIATION PROGRAM, VOLUME 2 Interim Technical Report, 1986
Rodney C. Darrah Apr. 1988 710 p
(Contract F49620-85-C-0013)
(AD-A198821; AFOSR-88-0721TR-Vol-2) Avail: NTIS HC A99/MF A02 CSCL 05B

Mini-grant research reports of the Air Force 1986 Research Initiation Program in vol. 2 include: Unified approach of the linear camera calibration problem; Survival analysis of radiated animals for small sample sizes; Optimum shape synthesis for structures undergoing plastic deformation; Pulsed power conductors; Locally implicit method for computational aerodynamics; Fluorescent dye binding identification of asbestos on membrane filters and in bulk materials; Expert systems for optimal design; Synthesis of some new energetic materials; MBE grown Al-Cu alloy films; Simulation for priority handling algorithms; Neural network simulation generator, simulations of learned serial behavior,and a neural explanation of emergent communication; Data processing and statistical analysis of in-service aircraft transparency failures; Trajectory studies of the bimolecular reaction of H2Ov/H20; Development of a new finite element grid for limited area weather models; Automatic program generation from specifications using prolong; Novel aspects of organic electrochemistry in room temperature molten salts; Improved distributed operating system communication protocols; Tunable infrared to visible light conversion in rare earth and transition metal doped fluoride glasses; Optimal structural modifications to enhance the robustness of actively controlled large flexible structures; and MATRIX-based computer simulation of the cardiovascular system under +Gz stress. GRA

N89-14185# Universal Energy Systems, Inc., Dayton, Ohio.
AIR FORCE RESEARCH INITIATION PROGRAM, VOLUME 3 Interim Technical Report, 1986
Rodney C. Darrah Apr. 1988 725 p
(Contract F49620-85-C-0013)
(AD-A198822; AFOSR-88-0722TR-Vol-3) Avail: NTIS HC A99/MF A02 CSCL 05B

Mini-grant research reports of the Air Force 1986 Research Initiation Program in vol. 3 include: Use of the image algebra; Simulation studies of MICAP allocation systems for EOQ items; Computer modeling of infrared signatures; An intentional tutor; Two-dimensional flight simulation model for an aircraft with a rapidly rotating airfoil; Mission effectiveness analysis of an aircraft attacking passive targets; Synchrotron white beam topography of striations and interface breakdown of GaAs and of strain fields in Si; Complete statistical classification of natural surface roughness on gas turbine blades; Evaluation of atmospheric effects for operational tactical decision aid; Formation of a dynamic stall vortex on a pitching airfoil; Biodegradation of Aqueous film forming foam components in laboratory scale microcosms; Effects of telecommunication media upon group decision making processes within a multi-team situation assessment task; Can a supervisory control simulation system assess cognitive abilities; Effects on the BICFET of the Fermi distribution factor and the Al mole fraction; Warehouse layout program; Changes in perceived workload and physiological response associated with monocular versus binocular

viewing conditions; Finite element analysis of thermomechanically coupled stress and temperature fields; and Simplification of H (at infinity) compensators. GRA

N89-14186# Pacific Northwest Labs., Richland, Wash.
INTEGRATING THE DEVELOPMENT OF INNOVATIVE CONCEPTS INTO CORPORATE STRATEGY
R. M. Smith Mar. 1988 11 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. 1988
(Contract DE-AC06-76RL-01830)
(DE88-016314; PNL-SA-15769; CONF-880702-22) Avail: NTIS HC A03/MF A01

Most good innovative ideas come from individuals who become creatively stimulated when they least expect it. The challenge is to convert these good ideas into marketable products. Most scientists contribute greatly to the advancement of technology often without considering that their discoveries may solve a market need. Better communications and understanding of marketing objectives and techniques is needed, since the problem facing most large corporate executives is to convert fragmented developments into total market solutions. Several organizational approaches have evolved in the management of technology designed to address the possibility of maximizing benefits from creative ideas, but two will be discussed in depth in this paper. The first internally directed method is to incorporate innovative ideas into the portfolio structure of strategic business units. The second externally directed method is to form a technology transfer operation which leads to new corporate or external spinoff ventures. Both of these approaches deal with the problems of cost and risk associated with the crucial step of commercialization, but in different ways. The achievements of all participants in technological research will be greatest if individual efforts are clearly and efficiently coordinated. DOE

88 SPACE SCIENCES (GENERAL)

N89-14187*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ENVIRONMENT OF MARS, 1988
David I. Kaplan, comp. Oct. 1988 71 p
(NASA-TM-100470; S-587; NAS 1.15:100470) Avail: NTIS HC A04/MF A01 CSCL 03B

A compilation of scientific knowledge about the planet Mars is provided. Information is divided into three categories: atmospheric data, surface data, and astrodynamic data. The discussion of atmospheric data includes the presentation of nine different models of the Mars atmosphere. Also discussed are Martian atmospheric constituents, winds, clouds, and solar irradiance. The great dust storms of Mars are presented. The section on Mars surface data provides an in-depth examination of the physical and chemical properties observed at the two Viking landing sites. Bulk densities, dielectric constants, and thermal inertias across the planet are then described and related back to those specific features found at the Viking landing sites. The astrodynamic materials provide the astronomical constants, time scales, and reference coordinate frames necessary to perform flightpath analysis, navigation design, and science observation design. Author

N89-14188*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
REPORT OF THE IN SITU RESOURCES UTILIZATION WORKSHOP
Kyle Fairchild, ed. and Wendell W. Mendell, ed. Nov. 1988 85 p Workshop held in Lake Buena Vista, Fla., 28-30 Jan. 1987; sponsored by NASA, DOE, Large Scale Programs Inst., United Technologies Corp., Kraft Foods and Disney Imagineering
(NASA-CP-3017; S-581; NAS 1.55:3017) Avail: NTIS HC A05/MF A01 CSCL 03B

The results of a workshop of 50 representatives from the public and private sector which investigated the potential joint development of the key technologies and mechanisms that will enable the permanent habitation of space are presented. The workshop is an initial step to develop a joint public/private assessment of new technology requirements of future space options, to share knowledge on required technologies that may exist in the private sector, and to investigate potential joint technology development opportunities. The majority of the material was produced in 5 working groups: (1) Construction, Assembly, Automation and Robotics; (2) Prospecting, Mining, and Surface Transportation; (3) Biosystems and Life Support; (4) Materials Processing; and (5) Innovative Ventures. In addition to the results of the working groups, preliminary technology development recommendations to assist in near-term development priority decisions are presented. Finally, steps are outlined for potential new future activities and relationships among the public, private, and academic sectors. Author

N89-14189*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
REMOTE SENSING IN POLARIZED LIGHT
Victor S. Whitehead and Kinsell L. Coulson (California Univ., Davis.) Oct. 1988 40 p Proceedings of Workshop held in Houston, Tex., 3-5 Nov. 1987
(NASA-CP-3014; S-577; NAS 1.55:3014) Avail: NTIS HC A03/MF A01 CSCL 05B

Preliminary analysis of polarized images of earth collected by hand-held cameras on Shuttle Missions 51A, 51G, 51I, and 61A indicate that information of the earth's surface and atmosphere exists in those data. To ensure that follow-on research in polarization is focused upon and that the experiments are properly designed to address specific questions, 26 scientists with past experience and interest in polarization observations met at the Lyndon B. Johnson Space Center on November 3 to 5, 1987. This conference report summarizes the discussions and provides the recommendations of the group for follow-on research. Author

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N89-14190 Harvard Univ., Cambridge, Mass.
PART 1: DEVELOPMENT OF THE ENERGETIC X-RAY IMAGING TELESCOPE EXPERIMENT; AND, PART 2: STUDIES OF LOW-MASS X-RAY BINARIES Ph.D. Thesis
Michael Rafael Garcia 1987 360 p
Avail: Univ. Microfilms Order No. DA8806082

The design, development and testing of the Energetic X-ray Imaging Telescope Experiment (EXITE) are described. EXITE should have sensitivity sufficient to perform many important observations of the high energy X-ray emission of galactic and extra-galactic sources. The combination of moderately large effective area, coded aperture imaging, and improved energy resolution should allow some of the most accurate measurements of high energy X-ray spectra to date. The results of a survery of the temporal and spectral variations of approximately 40 low mass X-ray binaries (LMXRBs) observed with the Einstein MPC are reported. A variety of methods were used to search for correlations among measured spectral and temporal parameters with the following results: as was found in previous studies, the spectra of many LMXRB harden with increasing flux; most X-ray luminous LMXRB often have hardness ratios which are bi-valued with luminosity, in contrast with the less luminous source; and a few of the more interesting sources were followed up at X-ray, radio, optical, and infrared wavelengths. Dissert. Abstr.

N89-14191# Air Force Geophysics Lab., Hanscom AFB, Mass.
RECENT ASTRONOMICAL RESULTS OBTAINED WITH THE AFGL TEN MICRON ARRAY SPECTROMETER Report, Oct. 1984 - Sep. 1987

Paul D. LeVan and Peter C. Tandy 27 Aug. 1988 12 p
(AD-A198887; AFGL-TR-88-0178) Avail: NTIS HC A03/MF A01 CSCL 03A

The detector array used is the 58x62 Si:Ga with the switched-MOSFET readout. Support electronics include the clocked address circuitry, 12 bit AD conversion boards for each of the two output lines, and 20 bit RAM coaddition blocks for both telescope chop positions. In operation, the data are coadded over several chops, differences are taken between the two chop positions, and these differences are subsequently output to a PDP 11/34 minicomputer. The mosaic array was characterized for high speed operation (5 msec frame periodicity) and linearity in a test bed dewar, and found for proper bias voltages to be sufficiently fast to permit the signal electron rate from sky and telescope backgrounds. The optics are a NaCl prism slit spectrometer for operation in the 8 to 14 micron region. The ratio of collimator and camera focal lengths is 3.6, resulting in arcsec pixel sizes for the Wyoming Infrared Observatory (WIRO) 2.3 meter telescope. We report here on the recent observing run at WIRO, the second for the Array Spectrometer. The latest observing run resulted successfully in measurements of IRC + 10216 with the mosaic array in full scanning operation. Results include spectral and spatial scans for IRC + 10216 and evaluations of instrumental performance. GRA

N89-14192*# Chicago Univ., Ill. NASA/Fermilab Astrophysics Center.
SUPERNOVA 1987A, ONE YEAR LATER: A SUMMARY OF THE LA THUILE SYMPOSIUM
David N. Schramm Apr. 1988 26 p Symposium held in La Thuile, Italy, 28 Feb. 1988 Prepared in cooperation with Fermi National Accelerator Lab, Batavia, Ill. and Max-Planck-Inst. fuer Physik und Astrophysik, Munich, Fed. Republic of Germany
(Contract DE-AC02-76CH-03000)
(NASA-CR-184612; NAS 1.26:184612; DE88-011147; FNAL/C-88/45-A; CONF-880288-4) Avail: NTIS HC A03/MF A01 CSCL 03A

The Conference reviewed what we have learned after one year from SN 1987A. In particular, new information continues to come in daily on the evolving spectra, including X-rays and gamma rays. We now know the light curve was indeed powered by (56)Co decay. The neutrino data from IMB and Kamioka continues to be analyzed. It is fit very well by a standard collapse to a neutron star although some nagging problems with the angular distribution remain. Constraints on neutrino and other weakly interacting particle properties have been developed that rival or exceed terrestrial laboratory results. The question of the counts detected by the Mt. Blanc neutrino detector had new mysteries added at this meeting as reports of multiple coincidences with gravitational wave detectors at Maryland and Rome were presented. Future supernova rates were also discussed. It was argued that neutrino detection from a future supernova in our Galaxy might be the only way to prove that the upsilon sub tau was the dominant matter of the Universe. DOE

N89-14193*# Columbia Univ., New York, N.Y. Astrophysics Lab.
ULTRAVIOLET OBSERVATIONS OF SELECTED ASTRONOMICAL SOURCES Final Technical Report, 1 Jul. 1986 - 31 Aug. 1988
Jules P. Halpern Dec. 1988 27 p
(Grant NAG5-823)
(NASA-CR-184585; NAS 1.26:184585; CAL-1732) Avail: NTIS HC A03/MF A01 CSCL 03A

The results of the 9th and 10th IUE episode programs listed are summarized. Observations and basic data reductions were completed for 4 extragalactic programs which were allocated a total of 9 US1 shifts, and 2 stellar investigations which used 10 US2 shifts. Use was made of the Goddard RDAF to obtain better signal to noise ratio spectra using the Gaussian extraction routines. Highlights include the first IUE observations of H1821+643, the second brightest quasar in the sky, and the discovery of accretion disk emission line profiles in the elliptical Seyfert galaxy Arp 102B. Both of these observations were accompanied by nearly simultaneous optical spectrophotometry. As a result of the stellar programs, large amplitude variability associated with the rotation period of the Ap stars 78 Vir and 53 Cam was found. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N89-14194*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 1: EXPLANATORY SUPPLEMENT
C. A. Beichman, ed., G. Neugebauer, ed., H. J. Habing, ed., P. E. Clegg, ed., and Thomas J. Chester, ed. (California Inst. of Tech., Pasadena.) Washington, D.C. 1988 455 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-1; NAS 1.61:1190-Vol-1) Avail: NTIS HC A20/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched on January 26, 1983. During its 300-day mission, IRAS surveyed over 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. Volume 1 describes the instrument, the mission, and data reduction. Author

N89-14195*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 5: THE POINT SOURCE CATALOG DECLINATION RANGE -30 DEG GREATER THAN DELTA GREATER THAN -50 DEG
Washington, D.C. 1988 410 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-5; NAS 1.61:1190-Vol-5) Avail: NTIS HC A18/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched January 26, 1983. During its 300-day mission, IRAS surveyed over 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. This is Volume 5, The Point Source Catalog Declination Range -30 deg greater than delta greater than -50 deg. Author

N89-14196*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 4: THE POINT SOURCE CATALOG DECLINATION RANGE 0 DEG GREATER THAN DELTA GREATER THAN -30 DEG
Washington, D.C. 1988 596 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-4; NAS 1.61:1190-Vol-4) Avail: NTIS HC A25/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched 26 January 1983. During its 300-day mission, it surveyed over 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. This is Volume 4, The Point Source Catalog Declination Range 0 deg greater than delta greater than -30 deg. Author

N89-14197*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 2: THE POINT SOURCE CATALOG DECLINATION RANGE 90 DEG GREATER THAN DELTA GREATER THAN 30 DEG
Washington, D.C. 1988 555 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-2; NAS 1.61:1190-Vol-2) Avail: NTIS HC A24/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched January 26, 1983. During its 300-day mission, IRAS surveyed 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. This is Volume 2, The Point Source Catalog Declination Range 90 deg greater than delta greater than 30 deg. Author

N89-14198*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 6: THE POINT SOURCE CATALOG DECLINATION RANGE -50 DEG GREATER THAN DELTA GREATER THAN -90 DEG
Washington, D.C. 1988 473 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-6; NAS 1.61:1190-Vol-6) Avail: NTIS HC A20/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched January 26, 1983. During its 300-day mission, it surveyed over 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. This is Volume 6, The Point Source Catalog Declination Range -50 deg greater than delta greater than -90 deg. Author

N89-14199*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 7: THE SMALL SCALE STRUCTURE CATALOG
George Helou, ed. and D. W. Walker, ed. Washington, D.C. 1988 348 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-7; NAS 1.61:1190-Vol-7) Avail: NTIS HC A15/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched January 26, 1983. During its 300-day mission, it surveyed over 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. Volume 1 describes the instrument, the mission, and the data reduction process. Volumes 2 through 6 present the observations of the approximately 245,000 individual point sources detected by IRAS; each volume gives sources within a specified range of declination. Volume 7 gives the observations of the approximately 16,000 sources spatially resolved by IRAS and smaller than 8'. This is Volume 7, The Small Scale Structure Catalog. Author

N89-14200# Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics.
ON A SCALAR FIELD IN SOME KANTOWSKI-SACH'S UNIVERSE
Hidekazu Nariai Nov. 1987 10 p
(DE88-752636; RRK-87-27) Avail: NTIS (US Sales Only) HC A02/MF A01

As a sequel to the previous note (RRK 87 - 24) on a scalar field in Nariai's universe with the topology Hermitian conjugate of S sub 2 x the tensor product of S sub 2, a similar field in some Kantowski-Sach's universe satisfying the vacuum Einstein equations R sub mu upsilon = lambda g sub mu upsilon (in similar to ours) is worked out. The resulting wave equation for the scalar field phi(t, x) is reduced to a second-order differential equation for T sub kl (t) (the time-dependent part of phi(t, x)) which is approximately solved not only in the neighborhood of x ident. to t/a(lambda a sq ident. to 3) approx. 0, but also in the neighborhood of x ident. to t/a approaching infinity. Such a work will be useful for dealing with its quantized version in connection with the pair-creation of those particles. DOE

N89-14201*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFRARED ASTRONOMICAL SATELLITE (IRAS) CATALOGS AND ATLASES. VOLUME 3: THE POINT SOURCE CATALOG DECLINATION RANGE 30 DEG GREATER THAN DELTA GREATER THAN 0 DEG
Washington, D.C. 1988 493 p Prepared in cooperation with Netherlands Agency for Aerospace Programs, Delft, and Science Research Council, London, United Kingdom Sponsored by NASA, Washington
(NASA-RP-1190-Vol-3; NAS 1.61:1190-Vol-3) Avail: NTIS HC A21/MF A01; also available SOD CSCL 03B

The Infrared Astronomical Satellite (IRAS) was launched January 26, 1983. During its 300-day mission, IRAS surveyed over 96 pct of the celestial sphere at four infrared wavelengths, centered approximately at 12, 25, 60, and 100 microns. This is Volume 3, The Point Source Catalog Declination Range 30 deg greater than delta greater than 0 deg. Author

N89-14202 Florida Univ., Gainesville.
MASS DETERMINATION OF SELECTED GALAXIES FROM SMALL GROUP STATISTICS Ph.D. Thesis
Lance Karl Erickson 1987 166 p
Avail: Univ. Microfilms Order No. DA8809635

The masses of carefully selected galaxies are measured with both rotation curves and by orbiting dwarf satellites. A comparison of the interior and the exterior masses of the observed primary galaxies provides an estimate of the dark matter, if any, in the surrounding regions. A comparison is also made between the results of similar studies which used binary galaxies and the small, compact groups used in this investigation. A comparison of the two distributions of exterior to interior galaxy mass ratios indicates that these distributions are not the same. Conclusions based on the n-body simulations of halo mass distributions limit the dark matter to approximately four times the group primary mass and four times the primary disk radius. The measured mass ratio values which exceed the model limit of 2 appear to be limited to the most massive or peculiar spiral and barred spiral galaxies. Dissert. Abstr.

N89-14203 Lancaster Univ. (England).
A STUDY OF GRAVITATIONAL PROPERTIES OF THE KAHLER EQUATION Ph.D. Thesis
Wathek Ahmed Omran Talebaoui 1987 145 p
Avail: Univ. Microfilms Order No. BRDX81916

The Kahler equation for an imhomogeneous differential form is coupled to the Einstein-Fluid field equations to construct a new cosmological model. Also discussed are the microscopic dynamics of the Kahler equation, and the solution of the Kahler equation in space-time of constant curvature is examined by using Riemann normal coordinates. Dissert. Abstr.

N89-14204*# Wheaton Coll., Ill. Dept. of Physics and Astronomy.
THE IONIZATION STRUCTURE OF PLANETARY NEBULAE. 9: NGC 1535
Timothy Barker [1988] 32 p
(Grant NsG-5376)
(NASA-CR-184566; NAS 1.26:184566) Avail: NTIS HC A03/MF A01 CSCL 03B

Spectrophotometric observations of emission-line intensities over the spectral range 1400 to 7200 A were made in five positions in the planetary nebula NGC 1535. There is some evidence for variation in the Balmer decrements between these positions. The

O(++) electron temperature varies little from 11500 K across these positions; the Balmer continuum electron temperature averages a few hundred K higher than this, but this difference is insignificant when compared to the measurement errors. As found for most of the other planetaries in this series, the wavelength 4267 C II line intensity near the central star implies a C(++) abundance that is several times higher that that determined from the wavelength 1906, 1909 C III lines. The discrepancy again decreases with increasing distance from the central star, again suggesting that the excitation mechanism for the wavelength 4267 C II is not understood. Standard equations used to correct for the existence of elements in other than the optically observable ionization stages give consistent results for the different positions; there is no evidence for any abundance gradient in the nebula. The logarithmic abundances are He = 10.99, O = 8.51, N = 7.63, Ne = 7.89, C = 8.34, and Ar = 6.08. The abundances agree well with determinations by Aller and Czyzak and by Torres-Peimbert and Peimbert and are nearly identical to those found for NGC 6826. As for NGC 6826, the rather low abundances of He, N, and C suggest that there was little if any mixing of CNO-processed material into the nebular shell in the progenitor to NGC 1535. The O, Ne, Ar abundances appear to be somewhat low, suggesting that the progenitor to NGC 1535 may have formed out of somewhat metal-poor material. Author

N89-14205# International Centre for Theoretical Physics, Trieste (Italy).
BLACK HOLES IN STRING-GENERATED GRAVITY MODELS
David L. Wiltshire Mar. 1988 31 p Submitted for publication
(DE88-703534; IC-88/56) Avail: NTIS (US Sales Only) HC A03/MF A01

Spherically symmetric solutions of d-dimensional Einstein-Maxwell theory with a Gauss-Bonnet term are classified. All spherically symmetric solutions of d-dimensional Einstein gravity coupled to the Gauss-Bonnet and Born-Infeld terms are derived, classified and compared with the previous solutions. Thermodynamic properties of the black holes are discussed and the black hole temperatures derived. Unlike the solutions of the Einstein-Maxwell theory the solutions with a Born-Infeld term do not appear to have a stable endpoint with regard to thermal evaporation. DOE

N89-14206# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR).
GRAVITATIONAL RADIATION IN RELATIVISTIC THEORY OF GRAVITY WITH A NONZERO GRAVITON MASS
A. A. Vlasov and Yu. V. Chugreev 1987 7 p In RUSSIAN; ENGLISH summary
(DE88-703544; IFVE-OTF-87-165) Avail: NTIS (US Sales Only) HC A02/MF A01

Radiation of gravitation waves have been analyzed in the linear approximation of the relative theory of gravity, with the mass of graviton being nonzero. It is shown that the main contribution to the energy loss due to gravitational radiation has been described by the well-known quadrupole formula. Linear approximation applicability conditions have been analyzed. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

No abstracts in this category.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N89-14207# Arizona Univ., Tucson. Dept. of Physics.
TESTS FOR THE PROPERTIES OF SOLAR GRAVITY MODE SIGNALS IN TOTAL IRRADIANCE OBSERVATIONS
Ronald J. Kroll, Henry A. Hill, and Chen Jian 1988 11 p Presented at the 27th Plenary Meeting of COSPAR, Espoo, Finland, 18 Jul. 1988 Sponsored in part by AFOSR, Washington, D.C.
(Contract DE-FG02-87ER-13670)
(DE88-015651; DOE/ER-13670/T2; CONF-880780-3) Avail: NTIS HC A03/MF A01

It has been found that a significant fraction of the gravity mode power density in the total irradiance observations appears in sidebands of classified eigenfrequencies. These sidebands are interpreted as harmonics of the rotational frequencies of the solar surface. The power density distributions in the sidebands are consistent with the observed differential rotation of the photosphere and the degree classifications of the respective gravity modes. These findings give further evidence that gravity mode signals are present in the total irradiance observations as well as give an independent check on the gravity mode detections and the l(ital) classifications. The small fraction of the power density remaining at the eigenfrequency of the gravity mode can account for the difficulty that has been experienced in detecting gravity mode signals in total irradiance observations. DOE

N89-14208# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 526, JUNE 1988. PART 1: (PROMPT REPORTS). DATE FOR MAY 1988, APRIL 1988 AND LATE DATA
Helen E. Coffey and John A. McKinnon Jun. 1988 117 p
(Contract N00014-86-F-0049)
(PB88-240403; SGD-526-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A06/MF A01 CSCL 03B

A detailed index is presented for 1987 and 1988 of solar-geophysical data. Data for May 1988 includes: UWDS alert periods (advance and world wide), Solar activity indices, solar flares, solar radio emission, and Stanford mean solar magnetic field. Data for April 1988 includes: Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, and Geomagnetic indices. Late data includes: Pioneer 12 interplanetary magnetic field for November 1987 and Geomagnetic indices for March 1988.
Author

N89-14209# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 526, JUNE 1988. PART 2: (COMPREHENSIVE REPORTS). DATA FOR DECEMBER 1987
Helen E. Coffey and John A. McKinnon Jun. 1988 43 p
(Contract N00014-86-F-0049)
(PB88-240411; SGD-526-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A03/MF A01 CSCL 03B

A detailed index for 1987 and 1988 is presented. Data for December 1987 include: Meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar X-ray radiation from GOES satellites, mass ejections from the sun, and active prominences and filaments. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N89-14210*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOLAR-FLARE SHIELDING WITH REGOLITH AT A LUNAR-BASE SITE
John E. Nealy, John W. Wilson, and Lawrence W. Townsend Dec. 1988 21 p
(NASA-TP-2869; L-16488; NAS 1.60:2869) Avail: NTIS HC A03/MF A01 CSCL 03B

The Langley high energy nucleon transport computer code BRYNTRN is used to predict time-integrated radiation dose levels at the lunar surface due to high proton flux from solar flares. The study addresses the shielding requirements for candidate lunar habitat configurations necessary to protect crew members from these large and unpredictable radiation fluxes. Three solar proton events have been analyzed, and variations in radiation intensity in a shield medium due to the various primary particle energy distributions are predicted. Radiation dose predictions are made for various slab thicknesses of a lunar soil model. Results are also presented in the form of dose patterns within specific habitat configurations shielded with lunar material. Author

N89-14211# Lockheed Missiles and Space Co., Palo Alto, Calif.
ENERGETIC PARTICLES AND ION COMPOSITION EXPERIMENT FOR CRRES Interim Technical Report, Aug. 1983 - Jun. 1988
J. M. Quinn and R. R. Vondrak 30 Jun. 1988 67 p
(Contract N00014-83-C-0476)
(AD-A198946) Avail: NTIS HC A04/MF A01 CSCL 04A

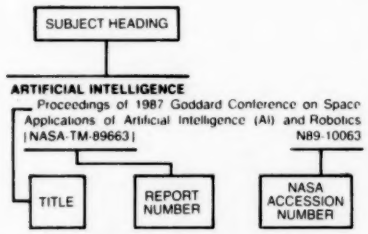
The ONR-307 Energetic Particles and Ion Composition instrument payload will measure the energetic particle and plasma environment of the Earth's radiation belts and inner plasma sheet. The payload has been successfully designed, built, and tested for flight on the Combined Release and Radiation Effects Satellite. The instruments were integrated with the spacecraft and tested with the integrated system. This mission, originally scheduled for shuttle launch in July 1987, will now be launched on an Atlas Centaur in June, 1990. The ONR-307 payload is currently undergoing final adjustments and calibration activities prior to re-integration with the spacecraft in May 1989. Procedures have been developed and documented for on-orbit operation of the payload and acquisition of the data on digital tapes. GRA

99 GENERAL

N89-14212*# National Aeronautics and Space Administration, Washington, D.C.
HISTORY AT NASA
Jun. 1986 59 p
(NASA-HHR-50) Avail: NTIS HC A04/MF A01 CSCL 05D

The efforts of the National Aeronautics and Space Administration to capture and record the events of the past are described, particularly the research accomplishments of NASA's agency-wide history program. A concise guide to the historical research resources available at NASA Headquarters in Washington, D.C., at NASA facilities around the country, and through the federal records systems is given. R.J.F.

Typical Subject Index Listing



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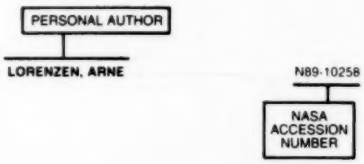

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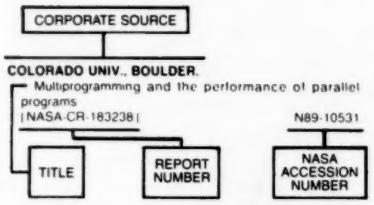

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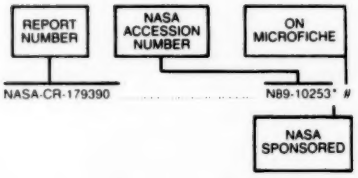

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